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CHRONIC ASCITES[1]

TREATMENT AND DRAINAGE BY LYMPHANGIOPLASTY THROUGH A TROCAR WOUND UNDER LOCAL ANÆSTHESIA. AN EXPERIMENTAL STUDY

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THE speedy replacement after tapping of large quantities of ascitic fluid, rich in proteins and salts necessary to the metabolism of the body, makes the patient pay very dearly for relief from distention, and greatly shortens the remaining period of life.

The hopelessness of the past should fade materially before the promise of success fulfilled in a number of cases of ascites, not due to malignant disease, following an intelligent combination of medical and surgical treatment. Although a cirrhotic liver can not be restored to its normal anatomic condition, and transplantation of normal liver tissue is still far off, recovery of its physiologic balance is possible in many cases through the arrest of the hepatic disease by the removal of toxic causes and by procedures to return the extravasated serum to the blood vessels.

The chief diseases causing chronic ascites do so by impeding the circulation of the portal system and by blocking the lymph channels of the peritoneum. A transudate from mechanical and constitutional causes, which offers an obstruction in the portal vessels, is subordinate to its cause: some patients suffering from peritoneal tuberculosis or from alcoholic hypertrophic cirrhosis have been known to recover without surgery, but a hydroperitoneum most frequently persists and both the liquid and the peritoneum are subject to variations which rarely end in recovery. Ascites from Laënnec's cirrhosis seems to have been cured in a number of cases by tapping, a straight and prolonged milk diet, and total abstinence from alcohol during the rest of the patient's life. Dieulafoy believes that the more a cirrhosis of the liver resembles the type described by Hanot and Gilbert as "alcoholic and hypertrophic cirrhosis," the more easily it is curable, and the farther it is removed from this type the less curable it will be; there is a compensatory hyperplasia in the former, while in livers with the atrophic tendency the lobules are destroyed. In most cases requiring paracentesis the peritoneum is pathologic and the stomata and the lymph vessels themselves are blocked, because the ability of the intact peritoneum to absorb fluids is almost unlimited. Temporary cures of ascites have followed repeated and even single tappings, any one of which may be followed by internal hæmorrhage, and the usual explanation is that in slow forming effusions time is given for the establishment of collateral circulations. Everyone who has performed

[1]Read before the Chicago Medical Society, May 28, 1913. Preliminary report made to the Medical Society of Milwaukee County, March 14, 1913.

paracentesis abdominis frequently has noticed that the fluid will at times leak from the wound for several days, and it is a possibility that the disappearance of an ascites after tapping may be due to a failure of the puncture on the peritoneal surface to close completely, thereby establishing a permanent drainage to the healthy subcutaneous spaces; another possibility is that enough collateral circulation through omental adhesions to trocar wounds contributes to these cures. This latter idea originated the Talma-Morrison type of operations. All records show, however, that in the great majority of cases of persistent ascites from whatever cause, excepting those relieved by catharsis, the pressure must be relieved by repeated tapping.

During the discussion which followed the reading of this paper, Dr. Doederlein of Chicago reported the following case corroborative of the above idea of one cause of the disappearance of ascites after tapping.

Patient 38 years, male; severe dyspnœa, palpitation, abdominal distention, extreme anæmia, emaciation, and cachexia; paracentesis of the enormously distended abdomen showed the ascites to be chylous; in about three weeks a second tapping was necessary and two or three weeks later the patient again asked for relief; gallons of chyle were withdrawn each time except at the last operation when only half a dram was obtained: the patient having fainted, the trocar was not reintroduced. The night and the day after the unsuccessful paracentesis he felt extremely ill, the abdominal wall about the site of the puncture became boggy and he claimed that he voided gallons of urine; he must have passed enormous quantities because the extreme abdominal distention had almost entirely disappeared. Paracentesis was never again necessary although there were some signs of reaccumulation for a few months. After one year the ascites disappeared entirely and now, seven years after, the patient seems in perfect health. Some nodular tumors felt in the posterior wall of the abdomen diminished in size or at least remained stationary after a prolonged course of X-ray therapy and iodides.

MEDICAL TREATMENT

The office of the liver as a filter for the products of all sections of the primitive gut must receive first consideration in the treatment of ascites due to cirrhosis. The reduced amount of normal liver parenchyma in cirrhosis and the corresponding reduction of its wonderful function greatly lessens its ability to rob the usual daily amount of septic and toxic products of the gut, received by the portal vein, of their dangerous properties; nor can the damaged liver with its impaired functions hold these poisons till disintegrated, diluted, or removed by its circulation, which has also suffered structural change.

The colon and its contents are not normally poisonous to the body; it is the great immunizer and vaccinator, but when toxicity of the contents of the large gut is present it must be reduced by a bland, or milk and salt free diet, by colonic irrigations, purgatives, and intestinal antiseptics. This condition must be permanently maintained during the rest of the patient's days. Correction of the intestinal toxæmia cures the gastro-intestinal enteritis common in these cases; it conserves the immunity of the patient, and it abolishes reflex disturbances by removing the definite removable causes of irritation which operate through the sympathetic ganglia.

Dr. N. S. Davis, Jr.,[1] has demonstrated the marked benefit obtainable by rest in bed for a time, withdrawal of alcohol, and exclusive milk diet, until fruit and other additions can be safely made. The cardio-vascular renal disease in many of these cases, which usually improves with the general and local improvement, is generally found to be due to a long standing imperfection of muscle, nerve, and heart circulation, as well as to a disturbed composition of the blood, and should receive special treatment by the home-made Nauheim baths, using acetic instead of hydrochloric acid, carefully regulated Schott resistance exercises, and also some cardiac stimulant until it can be dispensed with. It has been well said that this is an age of heart defects and no one can understand a patient's condition now without studying his heart, and no one can treat him properly without considering the management of his circulation. A good rule to follow for a strict milk diet has been evolved by the German clinicians, who have ascertained that a sufficient amount of nutriment from milk is in the number of grams represented by multiplying by twenty-five,

[1] Non-Surgical Treatment of Cirrhosis of the Liver. J. Am. M. Ass., 1913, lxi, July 26.

the number of pounds over one hundred of the body weight; e. g., if a patient weighs 250 pounds, multiplying 150 by 25 equals 3750 grams, or about four quarts; this is the maximum amount for 24 hours and is to be drunk in divided amounts every two hours. In ascites cases an allowance must be made for the weight of the ascitic fluid and œdema. This treatment should also correct as far as possible any renal insufficiency which often complicates these cases.

SURGICAL TREATMENT

Since 1896, when Talma, Drummond, and Morrison devised epiplopexy, several surgical procedures have been practiced for the relief of chronic ascites. The results of these operations have been fair, but the death rate high (20 per cent). Schiassi's method fixes the spleen and omentum in a recess of the abdominal wall. Mayo's method places the omentum anterior to the posterior sheath of the rectus by burrowing between two incisions, one over the liver and one 10 cm. (4 inches) lower.

Narath's method is very popular: Under local anæsthesia the fluid is let out through an incision above the umbilicus; a thumb sized, 10 cm. (4 inch) long piece of omentum is drawn out avoiding tension on the colon; the peritoneum is sutured around the base of the piece of omentum and the rest of it is placed in a subcutaneous pocket to the left. There is nothing to prove the theory that the good results after these operations are from collateral circulations, while there is much to show that the fluid finds its way directly to the subcutaneous spaces alongside the herniated organs where they have produced a defect in the abdominal wall which opens under pressure. Eck's fistula between the portal vein and the inferior vena cava is not only difficult but when accomplished has been followed by alimentary intoxication and death.

Gall-bladder drainage is indicated in the obstructive biliary type of toxic cirrhosis with ascites; this type has been produced experimentally many times.

Wynter, Handley's associate, tried femoral canal drainage, operating through the trocar wound after tapping, but it was difficult and tedious, a general anæsthetic was required, the opening was liable to be blocked at any time by omentum or intestine, or it would be sealed by reparative processes. Wynter also planted a flanged silver eyelet with a 7 mm. (¼ inch) wide opening subcutaneously in the linea alba, but it and other devices of this type proved failures.

Henschen,[1] after two efforts to provide drainage for ascites in a stomach cancer case, made a tunnel from an incision above the left spine of the ilium through the abdominal wall to a median incision opening into the peritoneal cavity; the mouth of an ordinary rubber condom was then sutured to the opening in the peritoneum, the condom was drawn through the tunnel and the blind end cut off, leaving it projecting the width of a thumb above the plane of the externus aponeurosis; this end was then spread out into a ring and sutured to the aponeurosis, and the skin was closed. The immediate result was an extensive œdema around to the middle of the back, the ascites was kept down, and the pressure disturbances of the heart and lungs subsided entirely. If the omentum is sutured out of the way the drainage might persist in this operation, but the hernia liability must be considerable.

Döbbertin,[2] under local anæsthesia ligates, divides and turns up about 5 cm. (2 inches) of the saphenous vein below Poupart's ligament, passes it upward under the ligament and out through a second incision just above it; a cuff of peritoneum is brought up between the external abdominal ring and the edge of the rectus and into it is sutured the end of the vein; the opening through the abdominal wall was made by splitting and is sutured open to prevent constriction of the vein. Döbbertin found that the blood from the vein did not escape into the peritoneum; he claims that the operation is simple and harmless, and adds that it may become necessary to repeat the operation on the other side later. Although this procedure returns to the blood by the most direct route the fluid which originally came from the blood, there are secondary

[1] Zentralbl. f. Chir., 1913, Jan. 11.

[2] Die directe Daurdrainage des chronischen Ascites durch de Vena saphena in die Blutbahn. Arch. f. klin. Chir., 1913, No. 4.

changes at times in the peritoneal fluid for which it might be better to return it to the systemic circulation by an indirect path or through the lymphatics.

SILK LYMPHANGIOPLASTY

Mitchell of Belfast first employed silk lymphangioplasty successfully in two cases of chronic œdema of the eyelid which had persisted for two years: the eyelids tend to drain by gravity whether the patient be standing or lying.

De Lambotte[1] of Antwerp was the first to use silk to drain the abdomen; he tied a large knot 6½ cm. (2½ inches) from one end of a thick silk thread 45 cm. (18 inches) long, put the knotted end in the peritoneal cavity and the rest of the silk under the skin of the thigh; marked œdema appeared the fourth day in the thigh but soon ceased because the intra-peritoneal end became embedded.

Mr. W. Sampson Handley gave surgery of the lymph vessels its first real impetus by his work in 1908, which he later made the subject of his Hunterian Lectures published in the British Medical Journal of 1910. His idea for artificial lymphatics came from the hopelessness of alleviating those agonizingly painful cases of brawny arm in the terminal stages of breast cancer, and a remembrance of some sections of a silk ligature which had been buried in the tissues for ten years, showing its fibers practically intact, no intrusion of cells between them, and no evidence of coagulation of fluids among the meshes. He inserted long double loops of number twelve tubular woven silk under the skin of the front and of the back of the swollen arms, leaving the ends lying in the healthy subcutaneous tissues of the shoulder and back. In all of his cases the pain was relieved completely in 24 hours, and the swelling gradually subsided from the hand upward in a fortnight. With a little practice this operation is easily and quickly performed and the results are very satisfactory. Of the ascites cases reported the most instructive and suggestive in many ways was one of Mr. Handley's.

[1] Semaine méd., 1905, p. 19. (This reference was not found till after the work for this article was completed.)

"A woman, 41 years, alcoholic, syphilitic, and in extremely bad general condition; on operation atrophic cirrhosis was found; the peritoneum generally was congested and oozed persistently when handled; long double silks were passed in and out in two places through the peritoneum and the subperitoneal tissues of the iliac fossa, leaving short loops exposed with the idea of their taking up fluid by capillary attraction; these strands were conducted close to the anterior superior spinous process, thrust through the abdominal wall and then down some distance into the subcutaneous tissues of the left thigh; the upper free ends were knotted. The abdominal wound was closed with interrupted sutures in such a way as to also provide drainage, by passing heavy silk through all layers of the abdominal wall except the skin and tying them tightly. At first the operation seemed a failure; the fluid re-formed and had to be tapped off 18 days later; the patient went home with an abdomen full of fluid, but returned some time afterward in much improved general health, though the abdomen was still full, though not tense, and its circumference had decreased; *surrounding the scar there was an œdematous area* (italics mine) 10 by 20 cm. (4 by 8 inches), a proof that the abdominal wound stitches were relieving the intra-abdominal tension. The skin of the thigh under which were the long threads, instead of being œdematous was somewhat less tense than the other thigh; three months later a crop of subcutaneous gummata appeared on the left leg below the knee and the leg began to swell; two months still later the left leg was markedly œdematous and presented numerous gummata, but the area of œdema about the abdominal wound had disappeared; the abdomen was flaccid and some free fluid could be felt; the patient was immensely improved in general health, free from pain, and was attending to her usual occupation."

Until five to seven months after the operation no proof was evident of drainage along the silks in the thigh, when the œdema appeared simultaneously with the crop of gummata; no specific treatment was given until nine months after the operation, and alcohol was a pronounced factor in the case.

The inferences drawn by the authors were that: (1) without causing œdema, drainage into the thigh had gone on ever since the operation; (2) if the absorptive power of the tissues is normal, and if the amount of fluid led into them is not excessive, the appearance of œdema is not to be expected; (3) local lymph stasis favors the onset of gummata in the affected part; and (4) the gummata in their turn interfere in some way with the return of lymph.

The silk lymphatics inserted down the

thigh in time certainly accomplished their object and contributed to recovery, but exception can be taken to these deductions. Granted that syphilis and alcohol played heavy etiologic rôles, and that the ascites if due to either or both is amenable to non-surgical treatment in some cases, there stands out from the order of the phenomena in this case the justifiable deduction that the drainage achieved found its way from the peritoneal cavity along the silk from the point where it emerged from the cavity, or, more exactly, at the angle formed by silk and peritoneum. The œdema which occurred first about the laparotomy wound along the tightly tied through and through stitches is explained as elsewhere by the physics of the conditions present. The several sutures of heavy silk closing the laparotomy wound passed through all layers except the skin and produced linear necrotic lesions of the tissues where each stitch was tied, or an opening extending from the peritoneal cavity to the subcutaneous spaces. These lesions were closed, as usual, as thoroughly as the peritoneum could do so, but a weak point had been created at each suture which the rapidly reforming ascitic fluid sufficiently overcame by pressure, aided by abdominal wall movements, to allow of seepage through to the subcutaneous lymph spaces, as shown by the œdema around the scar, about one month after the operation. Remember that the patient had to be tapped 18 days after the operation, then went home, but returned later with the œdema about the laparotomy scar and fluid still present in the abdomen but under no tension. In this case the only silk ends that projected into the abdominal cavity were the knotted upper ends of the long pieces which passed in and out of the parietal peritoneum; this silk was immediately buried by endothelial repair, or formed adhesions to the omentum, or both, which shut it off completely from the general peritoneal cavity, as experiments will show.

The drainage observed around the laparotomy wound took care of the excess fluid until the two long double silk strands, passing from the low point of the abdominal cavity through all layers of its walls except the skin into the subcutaneous tissues of the thigh, could in their turn form canals for permanent drainage, aided by their location, by hydrostatic pressure, and most of all by the movements constantly going on in the abdominal wall itself, which prevented a solid union of the silk to its bed in the tissues. It is just as probable, therefore, that drainage was not going on at this point from the time of the operation, as Handley and Wynter inferred, because in other reported cases some œdema was seen where expected, once drainage was established. The long delay of drainage by the lower four long silks was probably due to the facts that they were so few and so small, that they exerted no pressure on the tissues, and that the intra-abdominal pressure had been reduced; hence it took nearly three months before the fluid could find its way along them. The development of the leg œdema and the gummata was naturally coincident with the arrival of the infected lymph from the peritoneal cavity.

Briefly, in this case one tapping 18 days after the operation was necessary; the several tightly tied through and through sutures closing the abdomen provided considerable drainage through the channels they caused, aided by abdominal wall movements and by the intra-abdominal fluid under great pressure, in about one month; but the fewer silk drains penetrating the lower part of the abdomen, which were causing no pressure necrosis of adjacent tissues, required about three months of abdominal wall movements and of fluid under pressure and aided by gravity, to form about them the spaces for the passage of the fluid. A similar process is seen around the small perforating branches of the hypogastric artery when they persist about the upper rim of the umbilicus; here, the abdominal movements seem to wear loose spaces about these vessels, aided by their own pulsations, of course; these spaces become filled with fat, and in some cases are the undoubted starting points of ventral hernias.

A study of the few reported cases of this type of silk drainage for ascites and some experimental work makes the probability rather strong that the long loops of silk, partly in and partly out of the parietal peritoneum, are promptly and completely buried and that

Fig. 1. Note long ends coiled and free of adhesions in Nos. 1, 3 and 6 which died of acute peritonitis. Specimens No. 9 and 11 show short ends, adhesion free and covered by an extension of the peritoneum.

they contribute nothing to the desired drainage by capillarity, but that the actual point of escape of the fluid is at the angle formed by the silk and the peritoneum, where it reaches through to the healthy lymph spaces, and then along the sides of the silk.

After some consideration I undertook to investigate these various points.

EXPERIMENTS

Following this idea experiments were made on rabbits to ascertain the results of the efforts of the normal peritoneum to repair lesions made through it by drainage materials, using numbers 14 and 20 tubular woven silk, solid braided silk, split ¼-inch pure gum tubing, the rubber of finger cots and folded gutta percha tissue. About 60 different pieces of these materials were used. One end of each was inserted into the peritoneal cavity for a distance of 2½ cm. to 15 cm. (one to six inches) and the other end was placed under the skin of the abdomen. On account of technical difficulties with other materials No. 20 silk was selected as the best for this purpose.

One important fact was established by inserting several inches of the silk into the peritoneal cavity; two of the first six animals died of strangulation of the intestine caused by a twisting of the bowel around the silk after its free end had formed a firm adhesion to the mesentery, the part under the skin having held fast where placed.

In this connection it was observed that all of the long ends put into the normal peritoneal cavity immediately became adherent to the omentum or to any other organ with which they came in contact; whether this would be the rule with short ends in the presence of chronic peritonitis with effusion is doubtful (Fig. 1, Nos. 1–3–6), but if so it could not become a serious complication, the adhesion would probably soon disappear, and in no experiment did adhesions form over the angle of silk and peritoneum.

The gross specimens (Figs. 1 and 2) were recovered some in thirty and some in sixty days after operation; they all show that part only of the abdominal wall through which the silk projects from the peritoneal surface.

In Fig. 1, the specimens marked No. 1, No. 3, and No. 6 were from cases which died of peritonitis and intestinal obstruction within a few days after operation; the unhealed opening about the silk in these specimens shows as plainly as on the day it was made, but the most interesting and significant thing is the disposition of the long ends of the silk

in coils firmly glued by an exudate and with no adhesions; in specimen No. 1 heavy black silk was used and a part of its subcutaneous portion is exposed by a small incision through the peritoneum.

The two specimens marked No. 9 and No. 11, in which No. 20 white silk was used, show short intra-peritoneal ends which did not form any adhesions; these free ends had a smooth, glistening covering, and sections of No. 11 (Figs. 3 and 4) which was a thirty-day specimen, show a densely organized membrane of connective tissue outside of the silk and a general infiltration of its meshes by cells, single, in bundles, and in septa; although the angle of this silk with the peritoneum is plainly marked, the angle of No. 9, just below it, which is a sixty-day specimen, shows an actual ectropion of the peritoneum along the side of the silk, although there was no intra-abdominal pressure; this same condition was observed more or less in all of the specimens, the majority of which were secured 30 days after operation.

This angle is the place at which I claim that an intraperitoneal fluid must find its exit by pressure and gravity to the subcutaneous lymph spaces, along the outside of and not within the body of the silk.

Fig. 2 shows three thirty-day specimens in which long silk ends were left in the peritoneal cavity; two of them are deeply buried under many layers of omentum and in all of them the point of exit of the silk from the peritoneal cavity is quite free from adhesions; in time, through the constant wearing motions communicated to this fixed point it would become the same as in specimen No. 9, Fig. 1.

All of the long pieces of silk basted in and out of the parietal peritoneum in the original operations of Handley and others, as well as the long free ends I placed experimentally in the peritoneal cavity, are deeply buried by adhesions and by plastic exudate and are completely excluded from serving as drains for free fluid in the peritoneal cavity.

The drawings, although rough, show quite accurately the actual condition of the sections (Hektoen). The very extensive and early invasion of the meshes of the silk by connective tissue cells is so different a picture from that described by Mr. Handley in his case of the silk buried ten years and not showing cell growth among its fibers, that it is doubtful whether his idea of capillary drainage by the silk was correct, and also whether it is important that the silk used be woven in tubular form.

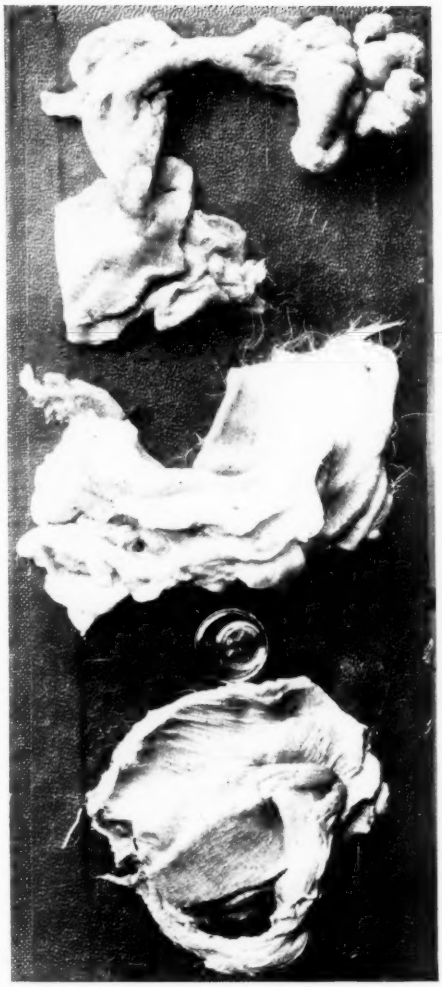

Fig. 2. Three 30 day specimens with long intraperitoneal ends, buried under many layers of omentum; the point of exit of the silk from the peritoneal cavity always remained free from adhesions.

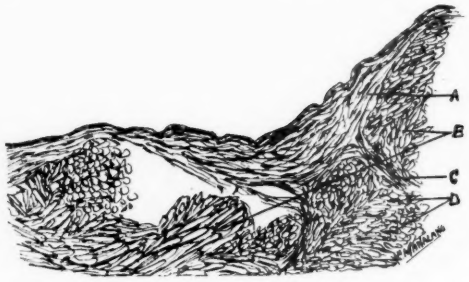

Fig. 3. Part of the cross section of the silk cord, after 30 days. (Fig. 1, No. 11.) A, connective tissue capsule encapsulating the entire cord. B, bundles of silk fibers infiltrated with fibroblastic cells. C, connective tissue septum between the bundles of silk fibers. D, fibroblast cells. (By Mr. C. Manalang.)

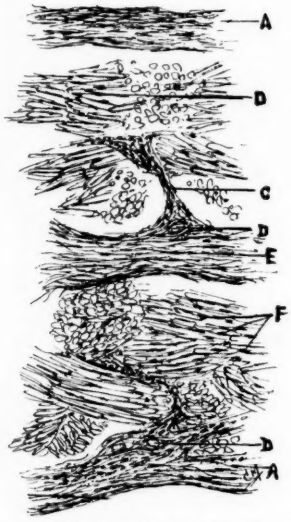

Fig. 4. Longitudinal section of the silk cord after 30 days. (Fig. 1, No. 11.) A, connective tissue capsule. B, silk fibers. C, connective tissue septum. D, cross section of one silk fiber encapsulated by connective tissue. E, connective tissue capsule between two main fiber bundles of silk cord. F, fibroblast cells. (By Mr. C. Manalang.)

SPECIAL INSTRUMENTS

Old instruments, found in almost every doctor's office, a sponge holder, a uterine sound, a silver catheter, a Péan forceps, and a Kelly endoscopic tube can be quickly made into the special instruments required. (Fig.6.)

The Silk Carrier (Fig. 6, E) is made from an ordinary Emmet's 25 cm. (10 inch) cotton carrier, or sponge holder, as it is sometimes called (Fig. 6, C), and a No. 14 standard guage silver catheter (Fig. 6, D); remove handle from the carrier by heating it in a flame and take off the ring also; cut from the straight part of the catheter a section 11 to 13 cm. (4½ to 5 inches) long, slip this tube over the shaft of the dismantled sponge holder and the "silk carrier" is made (Fig. 6, E). The Emmet sponge holders vary greatly in size and the heaviest type when grasping three strands of number 20 silk may not pass readily through the cannula.

The Bodkin. Remove the handle from a plain 30 cm. (12 inch) Sim's uterine sound (Fig. 6, A); fashion the square end into a probe point and as near this end as practicable bore an eye 9 mm. (⅜ inch) long by 3 mm. (⅛ inch) wide; this eye must be perfectly smooth and have rounded edges or the silk will not run through it as readily as it should. (Fig. 6, B).

The Trocar and Cannula (Fig. 6, F and G). On the handle removed from the sound, make a trocar point to fit a Kelly female endoscopic tube of the desired size; a tube 8 mm. (⅜ inch) in diameter and about 8 cm. (3½ inches) long (Fig. 6, G) will be the most useful size; the outside diameter of the instrument is that of a number 24 standard gauge sound; the Kelly cystoscopes are made in sixteen sizes. The ordinary trocar will do: the above is more convenient on account of its handle.

One Péan Forceps, Old Type. This seems to be the only hæmostat with an interval between its two parts just above the jaws (Fig. 6, H) which allows room for the silk, so that when the forceps is locked its jaws can fasten to tissues beyond the silks and yet hold them tightly; the length of forceps used is immate-

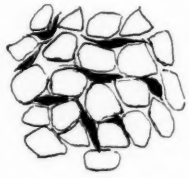

Fig. 5. Detail of a portion of silk fibers showing fibroblast cells between, after 30 days. (Fig. 1. No. 11.) (By Mr. C. Manalang.)

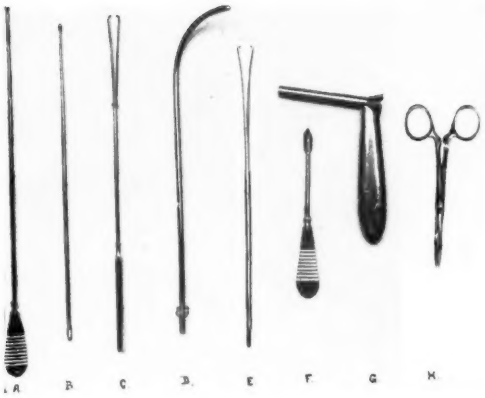

Fig. 6. A, Sim's uterine sound; B, same with handle removed, blunt end perforated and probe pointed, making the "Bodkin;" C, a 25 cm. (10 inch) Emmet's cotton carrier; D, a No. 14 standard guage catheter; E, the "Silk Carrier," made from C and D; F, trocar for the Kelly endoscopic tube; G, used as cannula; H, Péan forceps.

rial because the last 2½ cm. (1 inch) of all lengths is about the same size in each. This forceps is not essential.

TECHNIQUE OF OPERATION

The following technique was devised from work on animals, cadavers, and two clinical cases.

1. The point selected for the puncture should be just above the pubis and about 5 cm. (2 inches) to one side of the median line; the direction of the subcutaneous portions of the drains should be downward and outward over the groin and anterior surface of the thigh.

2. Infiltrate with one per cent of quinine and urea hydrochloride, or one per cent novocaine, the abdominal wall at the site for puncture, and the subcutaneous areas for the silk ends. After incising the skin 12 mm. (½ inch), perform the paracentesis.

3. Very little fluid will flow with the patient lying down, because there is little or no pressure and the omentun often blocks the cannula. After some of the ascitic fluid has escaped, pass through the cannula three pieces of No. 20 silk, 18 cm. (7 inches) long, grasped in the teeth of the carrier (Fig. 7), and on into the abdomen 5 to 8 cm. (2 to 3 inches) beyond the intra-abdominal end of the cannula; the

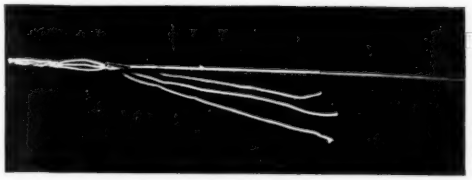

Fig. 7. The three pieces of No. 20 silk with about 4 cm. (1½ inches) of their ends stitched firmly together with fine silk, held in the silk carrier ready for insertion through the cannula.

sewed ends when the operation is completed, should extend about 1½ to 2½ cm. (½ to 1 inch) beyond the parietal peritoneum inside, the object being to leave at least 10 cm. (4 inches) of the silks under the skin and not over 2½ cm. (1 inch) projecting free in the peritoneal cavity; remove the cannula without disturbing the position of the carrier and silks, by slipping it carefully out over the carrier; allow the trocar wound to contract for about one minute and then slowly withdraw the carrier until satisfied that the ends inside are about 5 cm. (1 inch) beyond the inner end of the wound; anchor the silk firmly in this position by clipping across them the Péan forceps in such manner that its jaws bite strongly onto some fascia or other resistant tissue in the depth of the wound; the carrier can now be dispensed with. The carrier can also be used to anchor the silks either by having an assistant hold it firmly or by opening its jaws, allowing the strands to fall between the arms, and then getting a good bite of tissue in a deep part of the wound by ramming the tube part down hard; however, should the silks slip out during these manipulations the cannula can be reinserted into the abdomen by using the obturator which belongs to it as a cystoscope, and the silk can be replaced as before in less time than it takes to tell about it.

4. Cut the silks so that about 10 cm. (4 inch) lengths will lie subcutaneously and thread one of them through the eye of the bodkin; thrust the bodkin, eye first, from the trocar wound along one of the anæsthetized areas until the silk unthreads itself; then carefully withdraw the bodkin, pressing it away from the silk so as to leave it lying in the tunnel made by the bodkin; dispose of the other two pieces of silk similarly, remove the

forceps or carrier as the case may be, and after tucking the bends of the silk down into the wound, suture the incision very snugly with buried catgut and the skin with horsehair to get primary union and to prevent external leakage of the fluid. Another and perhaps a surer method of planting the subcutaneous portions of the silk is to thrust the probe pointed end of the bodkin from the wound for about 5 cm. (2 inches) farther under the skin than the length of the silk, point the end under the skin, incise and draw the bodkin out through the opening, leaving the silk to unthread itself in the track. Intraperitoneal pressure is desirable after this operation, but if the pressure symptoms are distressing one tapping may be necessary to give temporary relief.

When the special instruments are not available, the silk can be planted under local anæsthesia by a cutting operation through a short incision. One catgut stitch should anchor the silk to the deep fascia. They are easily inserted before closing the abdomen, after an exploration.

CONCLUSIONS

1. Patients with chronic ascites pay too dearly for relief from distention by tapping if the transudate, which is rich in proteins, salts, and the characteristic constituents of the tissues and fluids of the body, can be turned back into the blood stream from which it came.

2. Ascites patients have an impaired vital resistance, deficient powers of repair, and do not stand well extensive operations under a general anæsthesia.

3. A number of rather formidable operations for serous effusions have been successful, either by herniating an abdominal organ with the idea that this produces collateral circulations, or by a silk lymphangioplasty based on the principle of capillary drainage; a study of these clinical cases, and some experiments, seem to show that a fluid aided by pressure and gravity leaks directly under the skin along the space between the omentum, etc., or the silk, and its surrounding tissues. If this be true a simple operation with short silks will provide gradual drainage of the peritoneal pond.

4. The experiments show that the ends of three strands of No. 20 silk, sewed together, slightly projecting into the lower levels of the peritoneal cavity become a permanent silk-connective tissue peg; that the breach it makes in the abdominal wall allows the escape of fluid, and that the hernia liability is nil.

5. The procedure proposed need not confine the patient to bed for more than one day; is not much more formidable than an ordinary paracentesis abdominis, and can be repeated if necessary at any subsequent tapping until there is sufficient drainage.

6. The permanency of any improvement will depend upon the internal treatment.

INCONTINENCE OF URINE, COMPLETE AND INCOMPLETE[1]

By J. M. BALDY, M. D., Philadelphia

NO more hopeless condition exists than complete incontinence of urine, and none more annoying than incomplete incontinence.

Women are especially liable to these conditions, due largely to accident at childbirth, and in my whole experience I have known no condition so unsatisfactory to treat nor in which it was more difficult to obtain a good result.

During October, 1911, there was referred to me a woman, 28 years of age, who had had a difficult first labor with a posterior occiput. She had undergone repeated efforts at delivery at home and was finally taken to a city hospital when the delivery was completed. After delivery she was found to be "terribly torn" and operative work on the soft parts necessary. She underwent repeated operations and finally left the hospital with complete incontinence of urine, being told by the surgeon-obstetrician that nothing more could be done for her: her incontinence was incurable.

When she came to me an examination showed menstruation absent with complete atresia of the upper and inner end of the vagina. The scars of the operation for repair of the soft parts were plainly visible. Her urine ran from her urethra in a constant stream; at no time was she dry. From my past experience with this class the case seemed hopeless, especially as she had been in the hands of a very skillful surgeon-obstetrician who could give her no hope. I began to turn over in my mind the operative procedures with which I was familiar and wrote the authors of several of them as to their later experience and results. Almost without exception my answers were discouraging. The matter of a possible prodecure was constantly on my mind for the next several weeks, sifting the various theories of the several operations recommended from time to time by their originators: each and all seemed to me to be faulty. It appeared to me that the condition existing was somewhat similar to that of a hernia in that if a hernia once entered the canal nothing would stop its eventually traveling to the end of the canal. If a drop of urine once entered the urethra nothing would stop its passing through the urethra. As this self-evident fact fixed itself definitely in my mind I began to think of some method of preventing the entrance of the urine to the urethra. The neck of the bladder immediately monopolized my attention. The sum total of my cogitation resolved itself into a determination to attempt an operation on the woman which would bring pressure directly on the bladder end of the urethra. I admitted her to the Gynecean Hospital, and made my first attempt in this direction before the visitors in attendance at the Clinical Congress of Surgeons in session in Philadelphia at that time. She was admitted to the hospital on November 12, 1911, and left the institution November 21st of the same year. At the time of leaving the hospital she was retaining her urine from five to six hours. Four months later on looking her up it was noted that during the night she had full control but during the day could retain urine only one or two hours. With this condition she seemed quite content, but I persuaded her that another operation would probably give her further help.

She entered the Gynecean Hospital for the second time May 15, 1912, and I repeated the operation, taking care not to disturb the scar tissue of the former operation. She left the hospital eleven days later with good control.

On September 1, 1912, I received the following letter from her: "It is four months since my last operation and I can retain my water four to six hours at a time and pass from 8 to 10 oz. at different times."

"One swallow does not make a spring," nor does one case prove a principle, but where a procedure has been tried a number of times, even if a small number and in each and every instance succeeds, it is worth giving out for general use and experimentation. My colleague, Dr. Theo. A. Erck, who assisted me at my first operation later performed the same operation on a patient suffering with complete incontinence following childbirth, in the same institution, with an equally good result, as is testified to by the following quotation from a letter from the husband: "I enclose check in part payment. I regret my inability to settle in full at this time, though I will pay the balance soon. Should the amount charged have been ten times as much it would still be insufficient compensation for the operation which you performed for my wife and which seems to have been highly successful, as the desired result has been accomplished. Any expression of thanks on my part for the care and interest manifested by

[1] Read before the American Gynecological Society, Washington, D. C., May 7, 1913.

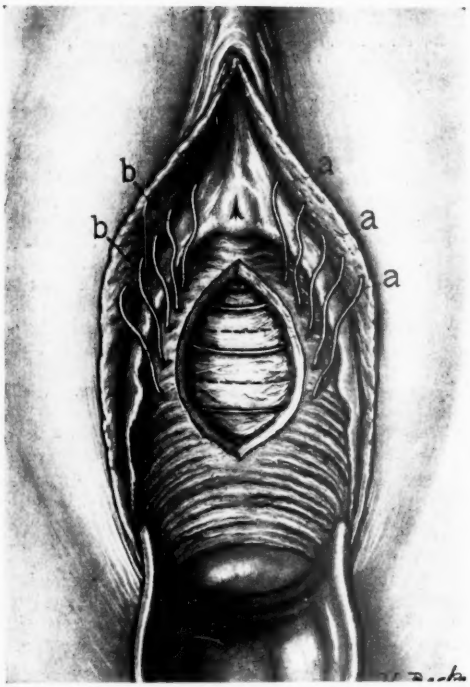

Fig. 1.

you in this case would be but a feeble apology for the gratitude I hold for you."

Having found an operative procedure upon which reliance could be placed, I tried it on the next two cases of partial incontinence which came under my care. Both women ejected urine at each step, on laughing or on the manifestation of any emotion whatever. Both had constantly to wear a napkin, which it became necessary to change frequently. Both women had borne children and had suffered from the date of childbirth. Both cases are completely cured. The last one wrote me in answer to a request for results, "I really have a very favorable report to make on my bladder; have had absolutely no trouble since my return."

These are the facts, and the profession can judge as well as I am able to as to whether I am warranted in believing that a long step has been made in solving the surgical cure of this most distressing condition. In any event, in every case in which the operation has been tried it has succeeded, even though the number of cases is small. The two encouraging points about it is the absolute lack of a single failure and the simplicity of the procedure.

The accompanying illustrations show the operation at a glance. (Figs. 1 and 2.)

The points involved are:

1st. To make permanent pressure on the neck of the bladder and the bladder end of the urethra.

This is accomplished, 2d, by bringing the vaginal mucous membrane and the underlying fibrous tissue from side to side so tensely as to make firmer pressure.

This is done, 3d, by making a denudation of the vaginal mucous membrane and the underlying fibrous tissue at the neck of the bladder; and, 4th, by bringing the edges of the incision together laterally by interrupted sutures of silkworm-gut; and finally, 5th, by placing a single reinforcing suture with which to take tension off the suture already placed.

The denudation is carried one half to three quarters of an inch both fore and aft from the neck of the bladder, in order to insure full pressure at the neck.

The denudation is an oval, the widest point of the oval being as near the exact neck as can be calculated, in order to insure most pressure at that point.

The width of the denuded oval is limited only by the possibility of bringing the edges forcibly together with the aid of tenacula. This is important, as it is this which gives the pressure.

The denudation is carried into, but not through, the underlying fibrous tissues: resection of this tissue is avoided. The object is to double the fibrous tissue on itself and get a deeper and firmer scar than could be gotten by a resection and bringing the comparatively narrow edges together.

The stitches are of fine catgut, interrupted. The first one is placed directly at the neck, in the center of the oval. They are introduced laterally, are brought out at the bottom of the wound and reintroduced to be carried across and out on the opposite side. Care

must be taken, however, not to leave a blind space in the depth of the wound.

Too much tension cannot be made on the stitches: the width of the denudation had better be overdone than underdone. The idea is to make it as tense at this point as possible in order to make the utmost pressure.

After all sutures have been tied the reinforcing suture is placed. The object of this suture is to draw the tissue from side to side of the vagina over the line of sutures already placed, so as to relieve them from tension until healing has occurred.

In placing this suture a point well away from the line of sutures directly at the point of greatest tension is chosen so as to make full allowance for the subsequent cutting of this suture. The needle is introduced in the direction of the long axis of the vagina, so as to get abundance of tissue. A quarter of an inch, longitudinal to the line of sutures, can be picked up on both sides of the line of sutures. The suture is carried in depth as far as possible without perforating the bladder mucous membrane. In this way a sufficiently large bunch of tissue is included in the grasp of the suture as to insure against cutting out before healing has fully occurred and the parts have adjusted themselves. The subsequent treatment consists in keeping the sutures as clean and dry as possible, and of the use of the catheter several times a day.

The sutures are removed at the usual time for plastic work.

Should the result not be fully satisfactory, as in my original case on the first effort, a subsequent similar procedure is easily possible.

In this connection I desire to refer to a paper presented by Dr. R. S. Hill, Montgomery, Alabama, to which my attention has been called by a friend whom I asked to look over the literature in the effort to find anything similar to the above operation. This paper was presented to the Southern Surgical and Gynecological Society in 1908. The dissection in this operation extended from the mouth of the urethra to one inch in the bladder wall, the extensive resection of the underlying tissues and the effort to pick up and unite imaginary vasicular tissue and muscles makes a formidable operation in comparison to the extreme simplicity of the one described above. There is no doubt, however, that Dr. Hill attained his success through exactly the same principle involved in my own; viz., pressure at the neck of the bladder by lateral tension. The balance of his procedure was superfluous in the light of the result attained by my own simple method. Dr. Hill told me somewhat more than a year ago that he had never had a second opportunity to test his method.

Fig. 2.

In view of his experience and of my own, it would seem that the way was open for other surgeons to test out results for themselves, and to put this operation on a definite plane.

OSTEITIS FIBROSA CYSTICA [1]

Report of a Case

By JAMES F. PERCY, M. D., Galesburg, Illinois

MISS H. M., age 23, born of Swedish parents in the state of Nebraska, presented herself for examination September 20, 1911. One of nine children. Her family history is negative except that an aunt died of pulmonary tuberculosis and the subject of this sketch visited her frequently. Personal medical history excellent, except whooping cough, measles and chicken pox; no sequelæ. When six years of age, she fell out of a farm wagon backwards and the left thigh was run over lengthwise by a corn planter. Right side of body not injured. Severe laceration of scalp at vertex. Was in bed only a few days from these injuries. Scar on right side of chin due to lacerated wound received when eight years of age while sliding down stairs. When six years of age, received another injury by falling off a wire fence and was caught by one of her feet. This wrenched one of her thighs, but cannot remember which one it was. When three years of age had a "running sore" of unknown origin on the outer side of the right heel. She did not wear shoes for over three months. The scar resulting from this lesion is nearly an inch long and half an inch wide. Menstrual history normal. No rheumatism or arthritis.

History of present condition for which she seeks relief: When twelve or thirteen years of age (1889) began to be lame in left hip. It was unaccompanied by pain, but sometimes a soreness of the muscles of the thigh on that side was referred to. The rather slight limitation of function at first, as expressed by limping, was quite easily overcome when her parents reproved her for it. The lameness was slowly progressive and there was no special pain until 1903. If she walked more than usual, or slipped, the pain became more acute. During the last five or six years could not run or do much walking and there has been more or less pain in the hip all of the time, whether resting or not.

Status presens, December 13, 1912: Weight 117½ pounds, temperature normal, hemoglobin 85 per cent, blood pressure 120 (systolic). Lungs negative. Heart, mitral regurgitant murmur, compensation good. Abdomen negative. Right thigh normal. Measurements: Right side, from anterior spine ilium to internal malleolus, 83½ cm.; left, 77½ cm. Left trochanter 4½ cm. above Nélaton's line. Region of left trochanter noticeably enlarged. Left lateral curvature of spine, middle dorsal. Left thigh smaller than right, at junction of upper third with lower two-thirds. Measurements: 44½ cm.; right, 46 cm.; above ankles, left 18½ cm.; right 19½ cm. Patient walks as if she had congenital dislocation of left hip. Wassermann negative. Diagnosis: Coxa vara.

The X-ray plates herewith presented necessitated, however (as it so often does when made use of in bone lesions), a revision of the diagnosis to that found in the title of this paper.

Treatment. The patient was put to bed and extension of the thigh attempted by heavy weights with the hope that the long existing shortening of the fascia and muscles would be overcome sufficiently to bring the limb down to its normal position. As the X-ray pictures show, such an attempt would seem indicated because of the extreme attenuation of the upper end of the femur in this case (Fig. 1). Nothing, however, was accomplished as far as lengthening the limb was concerned after six weeks of active effort with the weight and pulley. Under ether the joint was manipulated with the idea of stretching the capsule, fascia and muscles, and the weights reapplied for another two weeks, but again nothing was accomplished.

Operation December 4, 1911, at the Galesburg Hospital. Longitudinal incision extending above the great trochanter and below sufficiently to give access to the pathological tissue. It was found that the periosteal covering of the bone, only, was not involved in the disease. This was easily broken through with the knife, exposing a substance beneath that reminded one of soft cocoanut candy mixed with putty. When this was removed by a thorough use of the curette it was found that it was contained in cavities which averaged in size that of a large olive. The mass was cohesive, even elastic enough to be rolled out with the aid of the curette without fear of disintegration. The trabeculæ of the cavity were thin, very smooth, hard and translucent. As already stated, the periosteal covering was thin and easily penetrated with the knife or curette. The partition walls were but few in number, very dense, and arranged in such fashion as to suggest an attempt to strengthen the collapsing trochanter, neck and head of the bone. This description will also apply to the head of the bone in the acetabulum. There was a large quantity of this rubber or putty-like mass. When removed, it would easily have filled the ordinary breakfast coffee cup. One interesting fact incident to the emptying of the cavity by the curette was the practical absence of hæmorrhage. Nothing further of special moment occurred during the operation except that it was followed by a surprising amount of profound shock.

[1] Read before the Western Surgical Association at Cincinnati, Ohio, December 20, 1912.

Fig. 1. Left femur. The X-ray picture that made the diagnosis. The coxa vara position is well shown. The shaded maplike lines indicate the location of the trabeculæ that serve to strengthen the bone cavity and also act as containers for the cyst substance. Cyst pocket is shown in the lower end of the body of the ilium just above the acetabulum.

The thigh was encased in plaster of Paris extending from the breasts to the toes and sharply adducted with the hope of overcoming, as far possible, the coxa vara position of the neck. As will be seen (Fig. 4) by the X-ray taken fourteen weeks after the operation, nothing has been accomplished by this position. She wore the plaster spica twenty-nine weeks. She has used crutches until recently and still uses a cane in walking.

Fig. 3. Shows cysts of the head of the right femur.

Fig. 2. Multiple cysts of the left ilium. These were recently curetted and cavity filled with Mosetig's bone plug.

Fig. 4. Fourteen weeks after curettment of head of left femur.

Fig. 5. Cysts of the right ilium.

The operation has relieved her of all pain and given her a sense of security in using the joint that was not present previous to the removal of the diseased process. As shown by the X-ray of this patient's left ilium, this (Fig. 2) bone is also extensively involved in the disease. The head of the right femur, as shown by Fig. 3 is involved in the disease, but no signs of deformity have yet appeared. The disease here, and in the right (Fig.5) and left ilium, will be removed by operation at the first opportunity.[1] X-ray pictures of the whole body failed to discover other bones involved in the cystic process.

It gives the writer of this paper much satisfaction to be able to present to this association the report of a case suffering with a condition that so far has been observed but rarely in this country. It is his belief that the disease is not so uncommon as its failure of mention in the surgical literature of the English speaking world would indicate. It is to be hoped that the presentation of this paper, together with the X-ray plates taken from the case here reported, will excite interest in a most fascinating pathological and surgical subject.

Osteitis fibrosa cystica was first described by Von Recklinghausen[2] in 1891, as consisting of single, and, at times, multiple cysts. Pfeiffer,[3] whose paper covers the literature of the subject extensively and thoroughly, collected forty-nine reported cases. Of these, nineteen occurred in the femur, and in fourteen of this number the disease was in the upper end of the bone. Twelve were found in the tibia, and nine of this number were also in the upmost end. Of the humerus, ten cases are given, with eight at the shoulder. Other bones to be affected were the radius, ulna, fibula, clavicle, calcaneus, metatarsus, metacarpus, phalanges and skull.

Von Recklinghausen makes an interesting statement in his first paper, viz., that many tumors of bone, formerly classed as sarcoma, are undoubtedly only types of osteitis fibrosa cystica. In a more recent paper (1911) he tells us, in addition to the above, that most cases of cysts of bone are osteitis fibrosa. From the literature we learn that M. B. Schmidt, Mönckeberg, Glimm, Tietze, Pfeiffer and Rehn hold similar views. The conception of these authors as to the origin of these cysts as a distinct entity and separate from sarcoma gives added interest to the reading of the paper by Bloodgood of Baltimore on "The Conservative Treatment of Giant-cell Sarcoma, with the Study of Bone Transplantation."[4]

Bone cysts are found in tuberculosis, osteomyelitis, osteomalacia, sarcoma, myxoma and chrondoma. Hydatid and maxillary cysts should also be considered in this category.

Pfeiffer gives the age incidence in his collected cases as follows:

1–10 years	6 cases
10–20 years	29 cases
20–30 years	7 cases
30–40 years	4 cases
Above 40 years	3 cases

Von Mikulicz regards the disease, first, as one found during the growing period of life;

[1] The cysts in the left ilium were removed March 19th of this year. In emptying one cyst, the periosteal covering on the peritoneal side was broken by the curette. The emptied cavity was found to be trabeculated here also, but in a limited way as compared with the head of the left femur. The cavity was filled with the iodoform bone paste of Mosetig. No shock followed this operation as it did that on the femur.

[2] Von Recklinghausen. Festschr. d. Asst. f. Virchow, Berl., 1891.

[3] Pfeiffer. Über die Osteitis Fibrosa und Genese und Therapie der Knochencysten. Beitr. z. klin. Chir., liii, No. 2.

[4] Ann. Surg., Phila., Aug., 1912.

second, that it is a disease of the long bones; third, it is associated with an initial trauma; and fourth, it is a distinct process.

There are four theories as to the etiology of these cysts. First, that of Von Recklinghausen, who explains the disease on the basis of a mechanical process, perhaps following a trauma, and is sustained in this by Pfeiffer who points out that the disease is found most often in those bones and parts of bones which sustain the brunt of greatest activity in life through pull, weight or pressure. The second theory attributes the presence of these cysts to an infectious process. Both Lubarsch and Rapke, working separately, found organisms in the contents of the cyst cavity.

Third. Boit believes that the mechanical theory of Von Recklinghausen and Pfeiffer is not sufficient to explain the development of osteitis fibrosa cystica in all its forms. He would rather believe that the causes are various, viz., toxic, metabolic, traumatic, infective or some form of abnormal internal secretory change.

The fourth theory is that of Edward Rehn, who, in a most thoughtful article,[1] proposes, in contra-distinction to the theory of Von Recklinghausen and Pfeiffer, that the disease occurs not in those bones which, through pull or weight or pressure, are the most used, but in those bones and those parts of bones which are most involved in growth. This author considers osteitis fibrosa and the snuffle disease of hogs (Die Schnuffelkrankheit des Schweines) identical, and believes both of them to be an overdevelopment of a normal physiological process. He, by a most interesting course of reasoning, states that osteitis fibrosa is not an entity but a phase of dystrophy found in callus, rickets, osteomalacia, sarcoma, senile osteoporosis and Barlow's disease, etc., and, therefore, the diseases should be known as osteo-dystrophy malacia; scorbutica, deformans cystica, and the last disease (identical with osteitis fibrosa) should be divided into two groups, osteo-dystrophy deformans infantilis and osteo-dystrophy deformans senilis. The snuffle disease of swine belongs to the first group.

[1] Die Schnuffelkrankheit des Schweines und ihre Beziehungen zur Osteitis fibrosa infantilis des Menschen. Eduard Rehn, Beitr. z. path. Anat. u. z. allg. Path., 1908, 44, p. 274.

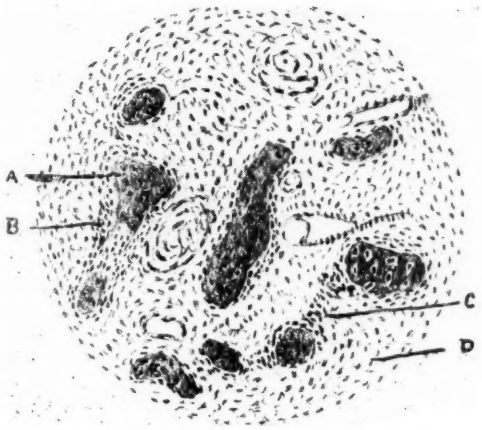

Fig. 6. A, islet of bone tissue. B, layer of cells rich in osteoblasts. C, layer of cells containing osteoclasts. D, connective tissue cells.

Boit,[2] in an interesting comparative study, teaches that the leontiasis ossea of Virchow and the osteitis fibrosa of Von Recklinghausen are histologically identical.

Bockenheimer [3] states that Paget's osteitis deformans and osteitis fibrosa are identical, pathologically.

Relative to the pathology of osteitis fibrosa, it is well to call attention to the fact that cyst formation in tumors is the result of softening in the center, whereas in osteitis fibrosa they result from a lacuna formation following a shrinkage in the surrounding soft tissues.

Pathology: The disease consists of multiple or single cysts occurring chiefly at the metaphyses of long bones causing them to become fragile, porous and easily bended. The process consists of an exaggeration of normal physiological growth with a proliferation of osteoid tissue in the formation of newly found small lamellæ of bone with a spongy absorption brought about through the agency of osteoclasts. The tissues surrounding the islets of bone are rich in round osteoblastic characteristic cell elements, at the outskirts of which may be found a number of osteoclastic cells. Between these islets, which give the tissue the appearance of a giant celled sarcoma, a number of spindle formed fibrous tissue ele-

[2] Boit. Über Leontiasis ossea und osteitis fibrosa. Arch. fur klin. Chir., xcvii, p. 515.

[3] Quoted by Boit.

ments are found. Numerous vessels are scattered throughout the tissue and here and there a recent hæmorrhage may be observed. The periosteum is rich in osteoblastic elements, but is otherwise normal (Fig. 6).

The symptoms are those of a very gradual and increasing loss of normal function extending over a period of years. Pain, also, is not pronounced until the part involved has first felt the discomfort incident to the loss of function. In the beginning, it is usually spoken of as an aching or soreness or stiffness, or even neuralgia. After unusual or excessive use, the bone involved is actually the seat of distressing discomfort which persists until the part has been given a period of rest. When the disease is in the upper end of the femur, the loss of function is not unlike that which is characteristic of coxa vara. The walking gait when the disease is advanced in the upper end of the femur reminds one of that seen in cases of congenital dislocation of the hip.

The course of the disease is persistently chronic. The osteoporosis, due to the persevering destructive action of the osteoclastic cells, weakens the bony framework to the point of deformity, suffering and uselessness. It is this that explains the frequency of pathological fracture which, according to Pfeiffer, occurred twenty times in his report of forty-nine cases. Curiously, this author advises against operative measures because the disease is essentially not malignant. He would use the knife only for the purposes of diagnosis or where the pain is excessive. Von Mikulicz recommends injections of iodoform emulsion. Boit, however, insists upon radical treatment.

The case here reported has been greatly relieved by the operative procedures followed. The pain is gone and the sense of insecurity and weakness in and about the hip has disappeared. True, the deformity has not been overcome, but this can be left to subsequent surgical treatment if it seems wise to attempt it. The most important problem, it would seem to the writer, is the method to be pursued in this case where the iliac bone, especially the right (Fig. 3), is so extensively involved. This question must also arise when the disease occurs in the small bones of the foot and hand or in the skull. It is necessary to remember that the disease always involves the endosteum and not the periosteum, and this fundamental pathological fact must be the basis of our interference to arrest destructive progress.

The indications for operation can safely be enumerated as follows:

First. Interference with function and the development of deformity.

Second. Pressure upon important vessels, nerves and organs.

Third. Prevention of pathological fracture from a large osteoporosis resulting from the disease. When this occurs, operation is contra-indicated, as a process of repair seems to be immediately initiated. It would appear to the writer that when the pernicious character of the pathology is considered, especially in relation to the ruinous work of the osteoclastic cells, a permanent recovery can be obtained in no way other than by radical operation.

ACUTE HÆMORRHAGIC PANCREATITIS[1]

Peritoneal Exudate Non-Toxic and Even Protective Under Experimental Conditions

By G. H. WHIPPLE, M. D., and E. W. GOODPASTURE, M. D., Baltimore
From the Hunterian Laboratory of Experimental Pathology, Johns Hopkins Medical School

THE experiments outlined below have an important bearing on the question of peritoneal drainage in acute hæmorrhagic pancreatitis, and we believe show that such drainage is contra-indicated. In some earlier work in this laboratory one of us became interested in the question of acute pancreatitis. At that time we were concerned particularly with the question of diagnosis in pancreatic disease and reported experimental work to show that the Cammidge test was quite unreliable (Whipple, Chaffee and Fisher). In many of the early experiments we studied the ferments, especially lipase, in the blood, urine and peritoneal fluid and could establish no constant deviation from normal which would serve as a diagnostic help.

The fact that the ferments were no more in evidence in the peritoneal fluid than in the blood serum or plasma suggested that this exudate had neutralized the ferments which presumably were set free by the pancreatic injury. Granting for the moment that toxic products might escape into the peritoneal cavity, it was thought that some neutralization might be effected by the same exudate. The series of experiments given below substantiates this view, and forces us to look upon the hæmorrhagic peritoneal fluid in these cases as a protective and neutralizing agent rather than a toxic one.

We shall not attempt to review the extensive literature on this subject, but refer to articles by Elösser, Hess and Bode for such references. All the writers during the past four years (Hess, Bode, Balch, Körte, Coenen, and others) speak in favor of operative drainage and some go so far as to say that there can be no recovery without drainage. Deaver states that one cannot expect recovery without operation and says, "it should not be forgotten that in this pancreatic exudate we have toxic material often sufficient to cause death." Körte repeatedly emphasizes the mopping out of the bloody peritoneal fluid as an important step in the operative procedure and favors drainage. His most recent article gives an excellent presentation of the subject of acute pancreatitis, and he emphasizes the fact that the disease is not rare, as is generally supposed. He points to complete recovery in the after-history of some of his cases which speaks for the great capacity of this gland to repair and regenerate, following grave injuries. Elösser states that the hæmorrhagic peritoneal fluid should be removed by lavage with salt solution.

It is quite clear that the peritoneal exudate in cases of acute hæmorrhagic pancreatitis is looked upon by the majority of surgeons as very poisonous. The various means of attaining this peritoneal drainage need not be discussed here — nor whether satisfactory drainage of such an exudate is possible. It may be of interest to speculate why such an unanimous opinion, for which there is no experimental evidence, has become fixed in the minds of surgeons. The peritoneal fluid may be very abundant and blood tinged, containing tiny flakes of fibrin and the serous surfaces somewhat injected. This is the picture one may find in early acute peritonitis due to streptococci or allied organisms and this similarity in appearance may explain the surgeon's fear of this peritoneal fluid. Surely no one can claim that in the usual type of acute hæmorrhagic pancreatitis, the peritonitis is due to bacterial activity. At times bacteria can be cultivated from this fluid or from the fat necroses, but they are looked upon as secondary invaders — usually the colon group.

The peritonitis and peritoneal exudate result from the injury to the pancreatic parenchyma which frees various ferments in an active form. These ferments injure all tis-

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sues with which they come in contact, especially the epithelium of the peritoneal cavity and adjacent fat. This injury and the presence of ferments in this cavity calls out a serous exudate, containing some fibrinogen and red blood cells. It is a well-known fact that the blood plasma is rich in antienzymes of many types, so there is no reason why this exudate should not tend to neutralize the various activated pancreatic enzymes. It will be recalled that the proteolytic enzyme of the pancreas is very active in digesting fibrin. The peritoneal exudate in acute pancreatitis usually contains small threads and clots of fibrin and these remain hours in this fluid *in vitro* without the slightest change, strong evidence of complete neutralization of all proteolytic ferments. The lipase of the peritoneal exudate equals in amount the lipase of the blood serum except in the last stages of a fatal case, where we may imagine that the process of exudation and neutralization came to a standstill; under such circumstances the lipase of the peritoneal exudate may be many times normal.

Etiology: This is certainly a vexed question, and we do not propose to go into a detailed discussion of this subject. The mechanism of retrojection of bile due to a small calculus in the tip of the diverticulum (Opie) can explain only a very few cases. Ascending infection of the duct (Williams and Busch) often associated with gall-stones in the common duct is a possibility in many cases, and recently at autopsy we have seen a case where there could be no reasonable doubt that such a direct ascending infection was responsible.

In an earlier paper from this laboratory (Whipple) it was pointed out that small *focal necroses* were often present in the pancreas examined at autopsy. These tiny focal necroses affect the acinar cells and when numerous are usually associated with small fat necroses scattered over the surface of the pancreas. This focal injury of the parenchyma is usually self limited and plays a rôle merely in chronic pancreatitis, but it is not difficult to imagine that under favorable circumstances such focal necroses with the escape of pancreatic ferments could lead to larger areas of necrosis, associated with hæmorrhage and leading to a progressive necrosis and inflammation. We have observed a case where scarcely any other explanation is applicable — the hæmorrhagic pancreatitis found at autopsy involved only the *distal* third of the organ, the gall and pancreatic ducts being normal and focal necroses were present in all parts of the head and body. What determines the spread of this acute necrosis and escape of activated cell enzymes is not clear, but it is obvious that under certain conditions the pancreas is much more susceptible to injury. This has been demonstrated clearly by several workers, and it is known for example that injection of substances during active digestion will cause more profound pancreatic injury than exactly the same procedure during a fasting period. It is noteworthy in this connection that acute hæmorrhagic pancreatitis occurs usually in persons in good health.

We have been interested in the question of intoxication following acute hæmorrhagic pancreatitis, and hope to publish in the near future detailed experiments dealing with the nature of this intoxication. When the work was begun it was thought that the peritoneal exudate might be toxic in spite of the fact that the enzymes were completely neutralized, but experiments in which large amounts of this peritoneal fluid were injected into small animals, intravenously or intraperitoneally, showed the absence of toxins in this exudate.

METHOD

In all these experiments the acute pancreatitis was produced by injection of pig's bile into the pancreatic duct. All operations were done upon dogs under ether anæsthesia with the usual aseptic precautions. The larger pancreatic duct can be easily exposed in the dog and a ligature passed about it to prevent back flow of the bile from the duct into the intestine. The bile was injected pretty rapidly, using a fine hypodermic needle and the ligature held for 1–3 minutes to give a uniform reaction of the bile on the parenchyma. Fresh pig's bile or that preserved with toluol varies considerably in its toxicity and the reason for this is obscure. When acute pancreatitis was produced in two dogs at the same time for the sake of parallel ob-

servation concerning the effect of exploration, removal of fluid, injection of exudate, etc., every effort was made to cause similar degrees of pancreatitis by using the same rapidity of injection, the same amount of bile per pound of body weight, etc. The fact that dogs appear to vary in susceptibility to this experimental pancreatitis must be kept in mind in interpreting the results.

The lipolytic activity was determined by means of ethyl butyrate .26 cc. in amount. Four tubes are prepared, each containing one cubic centimeter of fluid to be tested, diluted with 4 cc. distilled water. A little toluol .3–.4 cc. is added to prevent bacterial action. To two of these tubes is added .26 cc. ethyl butyrate, after the method of Loevenhart. The tubes are shaken, corked and placed in a thermostat at 38° C. for 20–24 hours. After cooling in ice water and adding a few drops of azolytinin the tubes are titrated to a neutral reaction in pairs, using tenth normal acid and alkali. Normal plasma will split the ethyl butyrate, freeing butyric acid to the extent of 0.2–0.3 cc. expressed in terms of tenth normal acid.

EXPERIMENTAL OBSERVATIONS

The experiments were nearly always done in pairs with collection of the exudate with aseptic technique from the peritoneal cavity of one dog with pancreatitis and injection at once into a normal dog or one suffering from an acute hæmorrhagic pancreatitis.

I. *Intraperitoneal injection into normal dog.* Peritoneal exudate obtained from Dog 60 was used to inject Dog 62.

Dog 60. Female, weight 17 pounds.

October 26, A. M. Operation and injection into the pancreatic duct of 4 cc. yellow, thick, viscid pig's bile. In 2–3 minutes there were many hæmorrhages all over the gland, an intense reaction. In afternoon the dog was very sick.

October 27. Animal was moribund and was bled to death from the carotid.

Autopsy: The peritoneal cavity contained 40 cc. of blood-tinged fluid. Pancreas is large, hæmorrhagic, œdematous and tense. Many fat necroses in omentum, parietal peritoneum, mesentery and intercostal spaces. Pancreas lobules are green and necrotic. Liver is large and red; lobules conspicuous. Peritoneal exudate gives a strong reaction for lipase. Thoracic duct contains hæmorrhagic fluid similar to peritoneal exudate, and gives the reaction for lipase.

Dog 62. Small female pup.

October 28, 11 A. M. Under ether anæsthesia 30 cc. of peritoneal exudate (Dog 60) were injected intraperitoneally. Pulse varied from 190 to 220 per minute, but was not influenced by the injection. P. M. Dog seems quite well.

October 30. Dog quite strong and active.

November 4. Animal was sacrificed.

Autopsy. Peritoneum, peritoneal and omental fat, pancreas and all the viscera quite normal.

II. *Intravenous injection of hæmorrhagic peritoneal exudate into normal dog.* Peritoneal fluid from Dog C-26 used to inject Dog C-27.

Dog C-26. Large adult male, weight 32 pounds.

January 17. Operation under ether anæsthesia, pancreas exposed and 2 cc. of fresh, filtered pig's bile injected rapidly into pancreatic duct, which is held closed for one minute. In a few minutes ecchymoses and œdema appear throughout the gland.

January 18. Dog dull and pretty sick. Operation and exposure of the pancreas. The gland is 3–4 times its normal size, very œdematous and covered with ecchymoses. Fat necroses are abundant about the head of the gland. Fifty cc. bloody fluid obtained in a sterile manner from the peritoneal cavity clotted, with the formation of a soft clot on standing. It was pressed through gauze and used to inject into C-27. During the operation there was considerable handling of the abdominal viscera. Abdomen closed tight. In P. M. dog is dull and pretty sick.

January 19. Dog is very sick; quiet; does not eat.

January 20. Improving; eats food.

January 27. Doing very well.

February 17. Sacrificed.

Autopsy. One adhesion in peritoneal cavity, between head of pancreas and liver. Lower arm of pancreas is small and fibrous; upper arm is not much changed. The repair of this pancreatic injury was practically complete in the upper arm but in the lower arm is seen some scarring and loss of parenchyma.

Dog C-27. Fox terrier female pup, weight 14½ pounds.

January 18, A. M. Under ether anæsthesia and with kymograph record 45 cc. peritoneal exudate (Dog C-26) were injected intravenously during 2–3 minutes. There was no change in respiration or blood pressure during 30 minutes. The dog was allowed to recover. 3 P. M. Doing well.

January 19. Doing well and dog is active.

January 20. In perfect condition.

III. *Intravenous injection of peritoneal exudate into dog with severe pancreatitis.*

Exudate from Dog 12–45 used to inject 12–46.

Dog 12–45. Male mongrel, weight 18½ pounds.

January 8, 10 A. M. Operation and injection into pancreatic duct 7 cc. fresh pig's bile; diffuse staining and ecchymoses in both arms.

January 9, 10 A. M. Dog lies on his side; very weak. Ether and laparotomy. Dog dies under light anæsthesia.

Autopsy at once. Peritoneal fluid is blood-tinged, and turbid. Soft gelatinous clot formed after collection with sterile pipette; filtered through gauze. Fat necroses and ecchymoses quite numerous all over peritoneum. Pancreas shows a black lower arm, with diffuse œdema and necrosis; upper arm hæmorrhagic and œdematous, but not necrotic. Lungs, liver, and spleen congested. Kidneys normal.

Lipase Init. alkalinity	.10–.10
Butyric acidity	.20–.30
Acid production	.30–.40

Dog 12–46. Mongrel male, weight 14½ pounds.

January 8, 10:30 A. M. Operation and injection into pancreatic duct 5½ cc. pig's bile. This dog received exactly the same amount of bile per pound body weight, injected in the same manner as dog 12–45.

January 9, 11 A. M. Dog is quiet and pretty sick. Ether anæsthesia with kymograph observation (20 min.). Blood pressure was low, but intravenous injection of peritoneal fluid, 98 cc. from dog 12–45, gave no effect.

January 10. Dog is in fair condition; has had bloody diarrhœa and is much emaciated. Wounds in good condition; 200 cc. milk given by stomach tube.

January 11, 11 A. M. Dog weak and emaciated, but walks about; given 200 cc. of milk by stomach. Shortly afterwards he vomited some of it.

January 12, 10 A. M. Found dead and cold.

Autopsy: Thorax negative. Peritoneum clean. Intussusception of mid-ileum and lower half of inverted gut is hæmorrhagic and gangrenous. Pancreas shows some œdema and opacity of parenchyma. Huge fat necroses around head and in the omentum. Fibrinous plastic exudate around head of gland and over duodenum. The gland shows a decided return toward normal and repair of injury.

IV. *Intraperitoneal injection of peritoneal exudate into dog with severe pancreatitis.* Exudate obtained from B-5 was used to inject B-1.

Dog B-5. Strong bull female suffering from distemper, weight 25¼ pounds.

November 29, 3 P. M. Operation and rapid injection into the pancreatic duct of 5½ cc. pig's bile and duct held closed one minute. Intense and very diffuse inflammation occurred all through the gland. Lower arm is one mass of hæmorrhagic splotches and the head is completely involved. Less in the upper arm but quite diffuse. Appears to be a fatal pancreatic injury.

November 30. Dog is eating as usual. No vomiting. Evidently is going to recover.

December 1. Dog ate all his food in A. M. before operation. Laparotomy under ether. Fat necroses abundant in .properitoneal fat, in omentum, and especially in the fat about the pancreas. Pancreas is very large (3 cm. in cross section), hard and stiff. Lobules are separated widely by œdema, and the parenchyma is slightly blood-stained. The peritoneal surfaces are very wet but only slightly injected except around the fat necroses; 22 cc. bloody fluid removed which contained small clots. Stomach full of food, but no lymphatic injection. Closed abdomen tight. The lipolytic activity of the peritoneal fluid was equal to that of the blood serum. 5 P. M. Dog is drowsy and appears sicker than B-1. Is dull and stupid.

December 2. Dog is improving. Eats and does not vomit. Weight 26 pounds.

December 3. Dog eating vigorously and looks better. Abdominal wound is breaking down.

December 4. Wound has broken down. Sacrificed with ether.

Autopsy: Peritoneal cavity clean. Pretty firm adhesions about the head of the pancreas. Lungs show extensive wet purple patches of bronchopneumonia. Pancreas about one-half or three-fifths the size it was at operation. It is quite firm and rigid. Fat necroses have quite vanished along duodenum and in omentum; indefinite patches of hæmorrhage show through the capsule, but they are especially numerous in the interstitial tissue between the lobules. The œdema has pretty well cleared up. Other organs negative.

Dog B-1. Small terrier, female, weight 12½ pounds.

November 29, 4 P. M. Operation and 2½ cc. pig's bile injected rapidly into pancreatic duct. Ecchymoses and staining all through the gland. The reaction was of moderate grade, not intense but quite diffuse.

November 30. Dog is sick. Vomits and will not eat.

December 1. Dog will not eat. Looks dull and stupid. Wound in good condition. The dog appears sicker than Dog B-5, which was done at the same time. Injected intraperitoneally at 12:30 P. M. with 22 cc. filtered bloody exudate from B-5. Animal was under anæsthesia 15 minutes. 5 P. M. Animal looks much better than Dog B-5, which had been explored with removal of exudate.

December 2. Dog looks pretty well. Eats and drinks. Weight 12½ pounds.

December 13. Dog in excellent health.

V. *Intraperitoneal injection of peritoneal exudate into dog with severe acute pancreatitis.* Exudate from Dog C-9 used to inject into Dog C-47.

Dog C-9. Young female, weight 11½ pounds.

March 22, 12 M. Operation and rapid injection of 6 cc. pig's bile. Diffuse staining of whole gland.

6 P. M. Dog is having convulsions, head retracted and there is much salivation. 11 P. M. Found dead.

Autopsy. Pancreas shows diffuse hæmorrhages and œdema all through the gland. Many fat necroses in

omentum and about the duodenum. Other organs negative. Bloody fluid in peritoneal cavity removed with pipette. Small clots formed over night.

Lipase—Init. alkalinity	.0– .0
Acid production	.70–.75

This is about double that of normal serum and this increase in lipase is seen only in the fatal cases where presumably the excess has not been neutralized or removed.

Dog C-47. Young male, weight 20 pounds.

March 22, 11 A. M. Operation and rapid injection into pancreatic duct of 10 cc. pig's bile. Diffuse and uniform bile staining of parenchyma. 6 P. M. Dog is pretty sick.

March 23. Dog is lying on his side, quite sick. 10:30 A. M., 34 cc. of peritoneal exudate from C-9 injected into peritoneal cavity.

4 P. M. Dog is very ill and drowsy. Pulse weak and thready; 90 cc. blood serum from normal dog injected intraperitoneally. Dog was kept on warm pad.

March 24, 10 A. M. Dog is quiet and curled up. Pulse better and there is a possibility of recovery. 12:30 P. M., 50 cc. normal blood serum injected intraperitoneally. Considerable pressure in peritoneal cavity; fluid returned through needle. Some pain on injection.

March 25, 11 A. M. Very sick and weak. Bile-stained vomitus under cage. Drinks a little water. 12 M. Aspirated 10 cc. blood-stained fluid from peritoneal cavity. Fluid contains small inconspicuous flakes.

Lipase—Init. alkalinity	.10–.10
Butyric acidity	.20–.30
Acid production	.30–.40

Ninety-five cc. normal blood serum which had stood 48 hours in ice box injected intraperitoneally. Dog vomits and has a very offensive diarrhœa.

March 26. Dog will stand up, but is weak. He drinks a little milk but vomits it at once. Pulse fair.

4 P. M. Aspirated 3 cc. blood-tinged turbid fluid from peritoneal cavity.

Lipase—Initial alkalinity	.10–.10
Butyric acidity	.15–.20
Acid production	.25–.30

Twenty cc. blood serum injected intraperitoneally. 400 cc. 0.9 per cent salt solution infused subcutaneously.

March 27, 9 A. M. Found dead.

Autopsy. Fat necroses very numerous and prominent in omentum, in peritoneum, in pelvis and intercostal spaces. Pancreas is large, hard and 3–4 times normal size. Much œdema and fat necrosis. There are greenish areas of necrosis. The peritoneum contains a few cc. of greenish blood-tinged fluid.

Lipase—Initial alkalinity	.10–.10
Butyric acidity	.80–.75
Acid production	.90–.85

Lungs: Bronchopneumonia and areas of necrosis.

VI. *Intraperitoneal injection of peritoneal exudate into dog with acute hæmorrhagic pancreatitis.* Exudate from B-28 used to inject B-29.

Dog B-28. Large female setter, weight 34 pounds.

December 23, 11 A. M. Operation and injection of 10–12 cc. fresh pig's bile into pancreatic duct. Considerable hæmorrhage. Diffuse distribution of bile.

December 24. Much vomiting this morning and during night.

3 P. M. Dog quite toxic. Laparotomy. Peritoneal cavity full of rusty, bloody fluid; surfaces wet. Omentum full of fat necroses. Pancreas very hard and immovable owing to the œdema; 60 cc. of bloody, turbid fluid with a few small flakes of fibrin were removed with a pipette.

Lipase—Initial alkalinity	.05–.10
Butyric acidity	.20–.15
Acid production	.25–.25

The abdomen was then closed tight. In P. M. dog was weak and drowsy; drinks water.

December 25, 10 A. M. Dog found dead.

Autopsy. Heart dilated with soft clots. Left lung congested and heavy. Liver shows great congestion. A fibrino-purulent exudate glues it to the pancreas. Pancreas 4–5 times the normal size and very rigid; it is mottled with areas of hæmorrhage and huge fat necroses, especially in head. The œdema is intense. One large hæmorrhagic area occupies the head of the pancreas and is covered with adherent loops of ileum. Fat necroses are seen all over the peritoneal cavity. Peritoneal fluid exactly similar to that at operation; little has accumulated; 10 cc. only could be obtained.

Lipase—Initial alkalinity	.05– .05
Butyric acidity	1.30–1.40
Acid production	1.35–1.45

Dog B-29. Small male pup, weight 6¼ pounds.

December 23, 12 M. Operation and injection of 1 cc. fresh pig's bile into pancreatic duct. All parts of pancreas involved. Well defined bile-stained œdema began to appear at once.

4 P. M. The animal is stretched out on his side. Looks moribund.

10 P. M. Improving, but looks very dull.

December 24. Still rather dull, and will not eat.

4 P. M., 51 cc. of bloody peritoneal exudate from B-28 injected intraperitoneally. No ill effects.

5 P. M. Pup is active as before injection.

December 25, 10 A. M. Pup seems pretty well.

December 27, 5 P. M. Pup curled up quietly in cage. Ate a little food. Soft, greenish stools.

December 29. Dog is walking around, evidently quite well.

The two preceding experiments emphasize in a striking manner the absence of any toxic

substance in the peritoneal exudate obtained from a dog suffering from acute hæmorrhagic pancreatitis. The entire exudate from a large dog with hæmorrhagic pancreatitis was introduced with no harmful effect into a small pup's abdominal cavity. This pup weighed less than one-fifth as much as the dog and was suffering from an acute hæmorrhagic pancreatitis.

From all our experiments we can say without hesitation that the peritoneal exudate is not harmful to normal dogs nor to dogs with acute pancreatitis. But to go further and say that it is protective is more difficult and may lay us open to criticism. From our experience we believe we are justified in stating that the peritoneal exudate is protective, that its outpouring and reabsorption causes more or less dilution, neutralization and absorption of the ferments and probably of toxic substances. Sulphonephthalein, when introduced on the day following the production of the pancreatitis, will be rapidly absorbed from the peritoneal cavity. The lymphatics and thoracic duct will be found to contain the same blood-tinged fluid as found in the peritoneal cavity.

It is probable that the most rapid absorption is by means of the blood vessels rather than by the lymphatics and everything points to a fairly rapid exchange of fluids in the peritoneal cavity — rapid outpouring and absorption. In some experiments we tried to hasten this exchange of fluids in the peritoneum by introducing normal serum and we can say with certainty that it was absorbed and did no harm. Whether it really did any great amount of good is less certain, but in principle the procedure seems logical and the results seemed favorable, although we realize that our observations may have been influenced by enthusiasm concerning the treatment.

We can say positively that where two experiments were done at the same time, the same amount of bile being introduced into the pancreatic ducts, etc., the dog which was subsequently explored, with removal of the hæmorrhagic peritoneal exudate, invariably was sicker or died sooner than the control dog.

It is quite remarkable when one considers the amount of injury which a pancreas can survive, provided only that the dog is left alone and the peritoneal cavity undisturbed. We need not suppose that the pancreas of the dog has this remarkable recuperative power while that of man is devoid of this factor of safety. It is fair to assume that the human pancreas under favorable circumstances can survive just as grave insults as that of the dog. We wish to cite two experiments illustrating some of these points.

SEVERE HÆMORRHAGIC PANCREATITIS RESULTING IN SCLEROSIS AND PANCREATIC INSUFFICIENCY

Dog 84. Fox terrier female, weight 19 pounds.

March 10. Operation, ether anæsthesia. Pig's bile (5 cc.) injected rapidly into the pancreatic duct. Bile-stained œdema and many ecchymoses appeared at once all over the pancreas. Abdomen closed tight.

March 11. Dog very sick. Vomits repeatedly.

March 12. Dog very sick and dull — vomits constantly.

March 13. Slight improvement; diarrhœa is present and stools are fatty, with blood and mucus.

March 14–16. Condition remains about the same with some general improvement; diarrhœa continues.

March 24. Dog is losing weight — 13½ pounds. Fæces are creamy yellow and abundant. Dog eats large amounts of food.

April 4. Enormous appetite and large amount of fæces.

April 19. Condition good. Fæces about five times normal in amount.

Operation and exploration of pancreas. The gland is replaced in great part by fibrous tissue, only a few nodules of parenchyma remaining about the head of the gland. A piece removed for section showed a remarkable degree of fibrosis with acinar destruction.

April 20. Good recovery from operation.

June 9. Dog is gaining weight — 17 pounds.

October–November. Dog continues well.

December 17. Dog is losing weight in spite of enormous amounts of food.

January 18. Dog continues to lose weight.

February 27. Dog greatly emaciated and has distemper. Killed with ether and autopsy at once. The pancreas shows a few old adhesions around its head. The lower arm is reduced to a thread of fibrous tissue and no parenchyma can be seen. The head shows a few tiny islands of parenchyma which are pigmented and yellow — not over 2 mm. in diameter. The upper arm shows a few scattered nodules of gray tissue embedded in scar tissue — the largest measuring 1 mm. in diameter. The section

shows a most extreme grade of chronic atrophic pancreatitis with only small clusters of acini and islands embedded in a mass of scar tissue.

HÆMORRHAGIC PANCREATITIS WITH NECROSIS AND ENCAPSULATION, FOLLOWED BY STRICTURE OF BILE DUCT

Dog 12–109. Male mongrel, weight 27 pounds.

April 26, 11 A. M. Operation; ether anæsthesia. Bile (20 cc.) injected rapidly into pancreatic duct. Œdema and ecchymoses appeared at once all over the entire pancreas. It appeared to be a fatal injury. Abdomen closed tight.

2 P. M. Dog looks very sick; has been vomiting.

April 27, 10 A. M. Dog looks very sick and will not stand up.

April 28. Dog looks a little better but still very sick.

April 31. Dog is much better.

May 10. Dog has been vomiting and losing ground. 4 P. M. Death.

Autopsy at once. Peritoneal cavity contained 200 cc. of blood-tinged fluid, rich in bile; the peritoneal surfaces are rather granular and show a little exudate. The common bile duct is narrowed and almost completely closed by scar tissue in the head of the pancreas, which is densely adherent to all the adjacent structures. Icterus is well marked. The pancreas is represented by a dense capsule of connective tissue in which one finds a core of soft, cheesy, necrotic material—the remains of the necrotic parenchyma. In parts of the organ one finds some nests of fairly well preserved hard pancreatic parenchyma. All the tissue shows old fat necroses and rusty staining, the results of hæmorrhage. Sections show great destruction of parenchyma with much formation of new granulation and scar tissue.

The two preceding experiments illustrate the remarkable recuperative power of the pancreas following a very extensive hæmorrhagic pancreatitis with necrosis. In both cases the abdomen was closed tight after producing the pancreatitis, which was looked upon as surely fatal. In spite of almost complete destruction of the gland, the injury was repaired and the necrotic tissue removed and replaced with scar tissue, in one instance the gland being represented finally by a fibrous cord. In the second case the new-formed scar tissue encapsulating the necrotic parenchyma, compressed the bile duct with appearance of icterus. It is not necessary to cite more experiments, but it is very easy to demonstrate the rapidity of repair in a gland suffering from an acute hæmorrhagic pancreatitis, provided the peritoneal cavity is not disturbed and drained. If the injury has been of moderate severity (see second experiment, Dog C-26) the repair will be nearly complete within one month and the amount of sclerosis and induration of the gland, considering the primary injury, will seem very slight.

SUMMARY

The peritoneal exudate in acute hæmorrhagic pancreatitis contains no toxic substances. It is harmless when injected intravenously or intraperitoneally in large amounts into normal dogs or those suffering from acute pancreatitis.

The ferments which escape from the injured pancreas are rapidly neutralized, and this peritoneal exudate usually is free from proteolytic ferments and contains the same amount of lipase as does the blood serum.

The hæmorrhagic peritoneal exudate may be looked upon as having a neutralizing action and appears to benefit rather than injure dogs suffering with acute pancreatitis.

Dogs with acute hæmorrhagic pancreatitis which are subjected to exploration and removal of peritoneal exudate will appear sicker than control dogs left undisturbed.

The pancreas can survive remarkable grades of injury and this factor of safety should always be considered in drawing deductions from any surgical procedure. Its capability of repair seems greatest when the gland is left undisturbed in a closed abdomen.

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A STUDY OF THE BENIGN POLYPS OF THE MALE URETHRA

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PRIMARY tumors of the urethra, both benign and malignant, occur, having their origin from the structures that form the urethral walls. They can scarcely be called frequent in their occurrence, yet sufficient have been described to show that they do occur more often than the usual textbooks covering such subjects would lead one to surmise. Oberlaender in 1887, frankly stated that he believed that urethral tumors in the male occurred as frequently as bladder tumors, or as caruncle in the female, and that their diagnosis is missed by incompleteness or the lack of endoscopic research.

Older literature contains many interesting references to such growths as found postmortem, and several of the museums abroad have preserved excellent specimens, but Tarnowsky, in 1872, first described the urethroscopic appearance of these tumors in the living subject. Since then a number of isolated cases have been reported, and the literature has been enriched especially by Grünfeld, who, in 1881, reported 18 cases of urethral neoplasm; by Klotz who, in 1895, cited 5 cases; by Burckhardt who, in 1906, added 20 cases; and by Frank who reported 8 cases in 1907.

Of the malignant tumors of the urethra, Oberlaender appears to have been the first to diagnose primary carcinoma of the urethra. His observations were made in 1893 and to the present time no less than twenty-five different writers have made similar diagnoses, while sarcoma has been met with by ten or more observers, three of these cases probably being true melanotic sarcoma of urethral origin.

The benign tumors of the urethra have had attention paid to them especially in the female, where the large group known as caruncles are not at all infrequently met with. This undoubtedly is due in part to the short length of the female urethra and the ease of examining the same. In the male, however, where we are justified in expecting similar conditions of etiological moment to arise, the case reports of benign tumors may be spoken of as rare, and the fact that but few investigators have been able to gather together a sufficient number of cases to deal with the varying pathological pictures, created the incentive for this study. It is interesting to find Lallemand, back in 1839, bemoaning the rarity with which the posterior urethra is examined at the post-mortem, and even if exposed how seldom indeed one sees fit to make sections of any part of it. This is as true to-day as the day it was written, and to this neglect is due the paucity of knowledge of the pathological changes that its walls undergo, as is also true of our lack of knowledge of the pathology of the colliculus, whose importance endoscopic work is daily proving to a reluctant profession.

One finds in going over the literature that there has been handed down to us a classification of these benign growths based upon their similarity in appearance to various worldly objects and hence we have such terms as polypus, if single and pedunculated; papilloma, if with multiple attachments; tuber, if raised and rounded; fungus, if mushroomed in shape; also the adjectives cauliflowered, villous, and dendritic, all of purely descriptive character. The various authors also speak of these growths in their descriptions as excresences and as vegetations, as carnosities and as fungosities, as caruncles and as condylomas, as papillomas and as glandular or adenomatous polyps, as fungoid and as papillary polyps; some are called papillary-polypoid angiomas, some vascular polyps, some urethral warts, and some urethral hemorrhoids, etc.

Those who have entered upon the histological study of these benign growths have tried to honor the usage of the older terms, and have thus gotten to apply many titles whose true meanings are obscured in the clash between macroscopic appearance and histological structure and origin. I do not wish to add new terms to the already overburdened nomenclature, for the time is not yet ripe for the classification of the neoplasms, and I will

try only to correlate the nomenclature, originating as it did from such descriptive macroscopic examination, and to attempt to group the growths from a histological viewpoint into types, as near as possible to correspond with the older terms.

The benign tumors of the urethra may be divided into the (*a*) fibromas; (*b*) myomas; (*c*) cysts; (*d*) polyps. Here the word polyp is used purely as a generic term, because of its freedom from histological significance, to stand as the name covering the entire group of benign, pedunculated or sessile, intra-urethral proliferations, not included in the other classes mentioned, and it is to this group, the polyps, that I desire to draw your attention at this time.

Though the material of this paper is limited to the polyps as they occur in the male urethra, a brief summary of the opinions one finds expressed in the literature and the terminology used, in both the male and the female, concerning these growths, will be necessary for a thorough understanding of the subject.

The terms usually used by the majority of authors in considering these growths divides them into four types, and they have generally been classified as either a polyp, a papilloma, a caruncle, or a condyloma. The terms vegetation and excrescence are very often used, and yet used so loosely that in many instances it hardly allows of any conclusion being arrived at as to what the writer has reference. This is especially true in the observations of the men prior to the time and the writings of Tarnowsky and of Grünfeld. To differentiate the four types of growths, above named, let us consider how the various authorities describe them, firstly from their macroscopic appearance and secondly from their histological study, for there is no end of difference of opinion, even among those who have given time to sectioning and to microscopic study of such proliferations. It is not my purpose to attempt to show this diversity of ideas, but rather to choose those whose views are acceptable, and try by their aid to summarize the prevalent opinion as to the true type designated by these terms, that are used so generally and yet with such a hazy meaning. The term "polyp" is but seldom found used when histological study has been performed and is usually left to designate the macroscopic appearance of the entire growth as it projects from its point of origin, giving a superficial yet circumscribed and narrow-based attachment. And here we will leave the term polyp, using it, as above stated, simply as a generic title for the entire class.

The term "caruncle" is extremely old and one can find a very interesting monograph on this tumor written by Ferri in 1552. However, in our present day knowledge and acceptance of the term, I cannot but agree with Burckhardt when he says that the caruncle belongs exclusively to the female, and with Neuberger, that it is their most frequently occurring urethral tumor. That similar growths occur in the male, probably owing to similar etiological factors, I do not doubt, and we must accept this name as typifying a type until we find out its analogue in the male and from its histological structure designate it.

From a macroscopic viewpoint Fritsch describes a caruncle as a "small, vascular growth covered with pavement epithelium, of varying lengths and mostly symetrically round or oval; it is seldom lobular." Shröder describes it as a "small, broad-based or pedunculated polypoid growth, which frequently develops at the urethral orifice." Burckhardt says "their color is dull red to bluish, their surface generally glazed, ofttimes rough and granular, that they are rich in blood vessels and bleed very freely on the slightest lesion."

Microscopically, Neuberger says that they consist of loose connective tissue, contain many greatly dilated blood vessels, whose lumina are ofttimes filled with mono- and polynuclear leucocytes. The cells of the adventitia are swollen and irregular, and the vessel walls thickened. Surrounding the vessels is a high-grade infiltration of typical plasma cells which often cover the entire vessel wall, or only part of it is surrounded like a wall. The epithelium is mostly of a many-layered pavement type, whose under layer is usually of cuboidal cells. He says: "An especially striking development of the papillæ, that is, an active epithelial proliferation (as in condyloma acuminata), was observed in only a few cases." Neuberger showed also

that the caruncles may vary rather widely in their histological characteristics, and he mentions finding some containing glandular tissue. More recently Lange devoted some time to the study of 58 specimens of caruncle which occurred in a series of 1000 cases examined; of these he showed that 19 were granulomas, probably of irritative (infectious) origin, while 39 were true new growths. He also describes glandular tissue occurring in some of his specimens. Williamson and Attlee in a critical study of the "Morbid Conditions of the Meatus Urinarius in the Female," substantiate the work of Lange as to the variation of the histology of caruncle. They subdivide them into various types, and apparently leave the older term "caruncle" to cover this entire class of neoplasms, in much the same way as I use the word polyp in this paper.

This review, unfortunately, does not lead us to a very concise idea of the histology of caruncle, but it proves to us that the term includes a typical macroscopic picture of a growth which on the other hand may vary in its histological structure.

The term "papilloma" is found very frequently used as descriptive of urethral growths, and is generally made to signify a polyp whose surface is visibly clefted and supports visible papillary outgrowths, and whose base is more sessile than pedunculated. One is always diverted while reviewing the literature by the interspersion of macroscopic and microscopic descriptions. Von Antal, for instance, who is frequently quoted, gives us the older conception, the macroscopic, in a nutshell when he says: "If the tumor has a smooth surface, a broad base and ends sharply it can be called a caruncle; if it has the same smooth surface but with an outspoken pedicle, it is designated by the name of polypus; if on the surface of the tumor are numerous warty projections, it is termed a papilloma; if the tumor possesses many new-formed vessels, we call it an angioma; yet all these conditions represent a fundamental type, a connective tissue tumor." Such is the conception in the minds of many to-day, that to be a papilloma a tumor should be visibly villous, or at least cauliflowered, in appearance, yet in one of my cases the true pathology was only revealed when a microscopic section showed it to be a villous forming growth. This corruption has lead Adami and McCrae to say: "The term papilloma conveys to the mind nothing but an anatomical description of the form of the tumor and makes no statement about its histological nature, yet for the class of tumors so described there is no term which is more used by the clinician, and we have therefore to utilize this term, coupled with a qualifying adjective to indicate the nature of the papilloma under discussion."

As for the microscopic appearance of the urethral papillomas they are as true to their type as any that are found elsewhere on the body. Burckhardt, Oberlaender and Neuberger all agree to limit this term to the neoplasms that have their origin from the proliferation of the papillæ and their vessels, which Neuberger emphasizes as "the essential characteristic."

However well the term papilloma, *per se*, is understood, there has been marked confusion created by the use of another word, also of what might be called macroscopic origin, to which various writers have tried to apply a typical microscopic picture. This is by the use of the term "condyloma" to describe a form of urethral growth. Winckel says he applies it to the poorly vascularized papillomas. Oberlaender says he differentiates the condylomas and papillomas "both quantitatively and qualitatively," quantitatively in that the former are found in many parts over large areas, and qualitatively in that they are distinguished by their volume and their firm structure. Grünfeld is frank and I believe nearer the mark when he says: "In individuals who have condyloma as a general covering in the region of the genitalia and are perhaps also affected with growths on the mucous membrane (vestibule, vagina, orifice urethræ), that they on the last analysis do not differ from one another and are less analogous to the polyps in their outer form than in their histological appearance. Even the described caruncle of Linhart scarcely dared be distinguished on microscopic examination, from polyps and condyloma. Therefore I make it a custom respecting the urethral mucous membrane, to use as synomymous the

terms polyp and condyloma." However, Burckhardt draws a distinction between the two, and this subject would not be complete without quoting the opinion of this careful observer. His point is this: "The papilloma arises generally from the papillæ and the abundant vessels; the latter, often dilated, lie in a connective tissue stroma that is rich in embryonic cells. The existing papillæ in different stages of hypertrophy carry on their surface a pavement epithelium; their vessels run parallel to their long axes. While the condyloma has in general, a histological construction the same as is true of the papilloma, yet it is constituted of stout fibrillary connective tissue, cell poor, and contains but few vessels. In consequence the entire tissue shows a firmer structure than the papilloma. The covering epithelium is very thick and epidermized, the entire surface cauliflowered or scalloped (cockscombed). In place of the high red, to bluish red color of the papilloma, we have a pale red to grayish white, approaching the color of the outer skin."

So, apparently, we have these three types of benign growth, occurring in the male or female urethra, varying as to degree and form of the structure of either the epithelial covering or the stroma, beginning first with the caruncle with its three or four layered epithelium and loose cellular connective tissue (the older conception); then to the papilloma with its hypertrophied papillæ, formed of a similar stroma and with a many-layered proliferating epithelium covering its villous projections; and finally the condyloma, characterized by a dense epithelium and a sparse, cell poor, and firm connective tissue.

However, when we recall to mind the anatomical features of the tissues that wall the urethra, and the fact that these small growths may arise from the proliferation of any or all of these tissues in varying proportions, such sharply drawn subdivisions into caruncle (angioma), papilloma, condyloma, et cetera, becomes a question of degree rather than of kind.

There is a form of benign polypoid growth occurring in the male urethra, which one finds mentioned by only a few observers (Burckhardt, Wechselmann, Lydston), and the reason is that only a histological examination will give the diagnosis. This type originates apparently from the hypertrophy of glandular structures, forming a polyp which contains definite glandular acini, and which Burckhardt says shows a certain similarity to the so-called mucus polyps of the nose, and from the work of Lange has also its analogue in one type of the female caruncle. Burckhardt reports five such cases, giving an illustration of the glandular area in two of them. Wechselmann reports one case, as does also Lydston.

There are yet two other types of new growth formation that occur in the male urethra that might be mentioned here, in order to make complete our conception of what has been observed on this subject. Firstly, the terms excrescences and vegetations have undoubtedly been applied to a form of proliferation of very superficial character, and closely akin to granulation tissue as seen elsewhere on the body. That the older writers used this term loosely is true, and undoubtedly included other forms of urethral growths. Their observations were mostly post-mortem findings and descriptions, but to-day as we see such conditions endoscopically, the resemblance is easy of recognition and the mistake will be less frequently made. The second type is the condition known as cystitis colli proliferans œdematosa, as first described by Zechmeister and Matzenauer, and considered by them to be due to a lymph stasis. The histological investigation of Zechmeister and Matzenauer showed it to be an œdematous infiltrated granulation tissue, with young connective tissue formation, showing in many places spindle formed cells; the interstices unevenly distended and stretched with a serous fluid. This subject has also been approached by Zuckerkandl in what he calls cystitis chronica proliferans. Orth calls it cystitis productiva. Kolischer œdema bulbosa, and Stoerk cystitis proliferans œdematosa. Most of these terms are applied as the condition occurs within the bladder, but its site of selection about the vesical neck, trigone, and internal sphincter speak for its being one and the same condition, both in its etiology, its pathology, and its appearance, whether it is localized to the bladder cavity or spreads down into or is localized

in the posterior urethra. Knorr considers it due to chronic irritation. Gross and Paschkis find an association between it and anomalies both psychical and sexual. Hertle cites a case occurring in the female urethra, while Gorodistsch describes it in the male, where it was associated as well with two definite polypoid proliferations. I have likewise examined a similar case endoscopically, and removed with an endoscopic rongeur one of the juicy, œdematous protuberations that lined the posterior urethra from the back end of the colliculus to the vesical orifice, and though it is my sincere regret that this specimen was lost to histological study, yet the endoscopic appearance was so different from that of any other type of urethral proliferation that I feel assured that the condition is one apart from the growths now at hand, where actual tissue formation has permanently taken place.

It has been my opportunity[1] to observe 9 cases of benign urethral polyp, herein reported, and the histological study of the nine specimens removed has allowed of a grouping of these cases on what seems to be a more scientific pathological basis than heretofore proposed.

Desirous of weeding out old and faulty nomenclature, and trying to place these growths of the male urethra upon a classification based on their histological structure, I would limit certain of the older terms to macroscopic appearances only. I know that it is ofttimes wrong to try to destroy time-honored terminology, yet when the same is at fault I do not believe in fostering misunderstandings; therefore, let the term caruncle be limited as Burckhardt and others claim it should, to the characteristic external urethral growth of the female, without reference to its histological structure, which may vary greatly, as shown by Neuberger, Lange, and Williamson and Attlee. Let the term condyloma be dropped from the classification of urethral tumors, certainly of the male, for a true type of this tumor has never been described in the male urethra. Whereupon, under the common name of polyp, the benign growths of the male urethra would show histologically the three following types, which I will endeavor to illustrate with cases:

1. Pure type or benign fibrous polyp.
2. Villous (or papillomatous) type or benign villous polyp.
3. Glandular type or benign glandular polyp.

[1] I wish to extend my thanks to Dr. E. H. Siter, Chief of the Genito-Urinary Dispensary, University of Pennsylvania, in which department the greater number of these cases were studied, and to Dr. A. J. Smith for his personal help in obtaining the micro-photographs.

BENIGN FIBROUS POLYPS

CASE 1. No. 1378. Age 29. Admitted April 7, 1912. Denies venereal infection. Complains of a slight discharge, a stinging pain during urination located at the peno-scrotal junction, and also under the glans. He has pain at no other time and in no other place. These symptoms have existed for the last three or four years. Glass No. 1 and No. 2 clear. Bulbous bougie No. 27 F. detects an "infiltration" at about two and a half inches from the meatus.

July 3, 1912. Patient has been regularly treated, during the last three months, with sounds, and has been twice cystoscoped, the bladder being pronounced negative. *Endoscopy.* Posterior urethra tender, colliculus is nodular and slightly irregular, walls of the urethra are injected and reddened. Utricle lies gaping in the mid-line. Silver nitrate application. Anterior urethra at about the suspensory lig. presents a polyp, hanging from the two o'clock aspect of its lumen; it is approximately one and a half cm. long, by one half of a cm. broad. Its walls are smooth. Removed with an endoscopic rongeur; 20 per cent silver nitrate solution applied to its place of attachment.

July 11, 1912. *Endoscopy.* Site of tumor appears œdematous and slightly strictured, probably due to the caustic. No apparent growth.

July 25, 1912. *Endoscopy.* Posterior urethra normal, area in ant. urethra that was cauterized is slightly strictured, due to an œdematous mucus membrane.

Aug. 30, 1912. Patient has been getting weekly dilatations with sounds with massage of the strictured area. *Endoscopy.* Posterior urethra normal. Site of polyp's growth much better and walls are but little thickened; central point is slit-shaped.

Sept. 3, 1912. Glass No. 1 and No. 2 clear. No discharge. Symptoms entirely gone.

The use of so strong a silver nitrate solution on a swab in the anterior urethra will not be tried again: it undoubtedly caused a local annular constriction, which however, soon cleared up. This patient described a vibratory thrill that he felt while urinating, and was able to associate the point at which he felt it, with the point from which the polyp was excised.

The growth (Fig. 1) illustrates the simplest

type of polyp. It is composed of a loose connective tissue stroma, with vessels running in its long axis, and a thin epithelial covering. There has taken place considerable extravasation of blood into the tissues, due most probably to the crushing with a flat-faced rongeur at the time of removal, as this patient never complained of any urethral hæmorrhage.

CASE 2. No. 58. Age —. Admitted August 12, 1912. History of previous venereal infection not given. Trouble of five years' duration. Complains of pain at the onset of urination, some pain and discomfort in the perineum and suprapubic region, no other urinary symptoms. No discharge. Never masturbated or passed any blood; no sexual disturbance except nocturnal emissions at least once a week.

August 12, 1912. *Endoscopy.* Colliculus very tender and three times normal in size, back of the caput on the left superior urethral wall in the region of two o'clock, is a polypoid protuberance, white walled and distinct in color from the surrounding engorged urethral mucus membrane. It is about 6 mm. long and can be moved about as if quite pedunculated, yet feels firm and stands outright from the wall. Seized with rongeur and removed with some difficulty because of its toughness. Base cauterized with silver nitrate stick. Ant. urethra normal. This patient has been lost to subsequent observation.

The specimen (Fig. 2) is a beautiful example of the benign fibrous type, with three or four layered epithelial covering, a loose, cell poor, connective tissue stroma, with the vessels running in the plane of the long axis and here and there a stray muscle fiber. Scattered at varying points on the surface one sees the common form of mucous gland dipping down into the stroma, while in the region of the base the epithelium presents a sight tendency towards redundancy and becomes somewhat thickened. On the side at one point is an area of round-cell infiltration, evidently due to a local infection of a mucous gland.

CASE 3. No. 1144. Age 44. Admitted Dec. 29, 1911. Has had gonorrhœa several times and now has a profuse discharge again. There is frequency and urgency present, but no hæmaturia. Glass No. 1 and No. 2 cloudy. Received regular treatment for acute gonorrhœal urethritis until the middle of May, at which time he still had a slight morning discharge, glass No. 1 was slightly cloudy, and glass No. 2 was clear. The prostate was slightly indurated and fixed, with a few adhesions, not enlarged, not tender; prostatic secretion showed a few pus cells. No. 29 F. sound passes to the bladder with ease.

May 24, 1912. *Endoscopy.* Pendulous urethra normal, bulbous urethra shows marked infiltration and œdema, mucus membrane lustreless and quite thickened (beginning stricture). In the membranous urethra is a small polypoid growth arising from the eight o'clock aspect of the urethral lumen; same was successfully removed with a curette.

July 28, 1912. Patient has continued soundings and to-day his urine is quite clear.

Unfortunately the specimen removed from this case was allowed to dry, and though subsequent treatment of it made sectioning and histological study possible, it does not warrant photography. However, it presents a loose connective tissue stroma similar to cases 1 and 2, with a rather marked extravasation of blood. There are definite blood vessels to be made out, connective tissue fibers, and a few muscle fibers. The whole was encased in a fairly thin epithelial covering which for the most part was pavement in type.

CASE 4. No. 564. Age 31. Admitted Feb. 19, 1913. Gonorrhœa five and seven years ago, no venereal sores. Complains that since "strain" two years ago he has had a small swelling on the under side of the urethra. This has not varied in size until three weeks ago it seemed to get larger and harder, and at the same time he first noticed a slight discharge. Urination was painful and it gave him a stinging sensation before onset. Has seen no blood, and has no chordee.

There is no discharge visible. Glass No. 1 and No. 2 clear. Under the urethra is quite a hard nodule the size of a large pea and about one and a half inches from the meatus. *Endoscopy.* In the region of the tumor a nodular swelling arises into the field from the floor of the urethra; the mucous membrane over it is pale and glassy, but not broken at any point. Just posterior to this area is a small pedunculated polyp standing upright from the floor of the urethra and about 8 mm. in length; it was seized with a rongeur and removed. The tumorous mass was twice incised deeply with an endoscopic knife from the urethral aspect, but no fluid was seen to exude.

Feb. 28, 1913. *Endoscopy.* The nodule is possibly one third smaller in size on external examination. From the urethral aspect the site of the polyp is covered with a linear scar, while the point of incision into the mass is ragged and slightly ulcerated.

The character of the associated tumor mass is questionable. The patient has not returned for any further observation; however, I feel that in all probability it was a benign encapsulated fibroma. The polyp stood upright and was solid and firm of structure. The section (Fig. 3) shows a benign fibrous polyp with the results of a chronic infectious process

superimposed upon it. The stroma is filled with a round cell infiltrate and there is a marked increase in the vascularity. The epithelium is of the same type as in the previous cases; the stroma, though infiltrated, is similar in its architecture with here and there a stray muscle bundle throughout it. This polyp may be subclassed (after Williamson and Attlee) as a granuloma, due to the marked round cell infiltration, though I believe its original structure to be the same as the foregoing cases, and the infiltration but the by-product of the chronic infectious process.

Remarks. This type of urethral polyp constitutes histologically the simplest formation, composed of fairly loose connective tissue, forming a fine fibrillary network and supporting thin walled vessels, the axes of which run parallel to the long axis of the growth. The vessels are engorged and at points extravasation has taken place (Case 1), but nowhere do we see such marked vascularity as would warrant classifying them as angiomata.

Localized round cell infiltration may be present, probably due to a focus of infection (Case 2). In Case 4 there is a general round cell infiltration throughout the growth, associated with chronic granulation tissue, undoubtedly due to a continued infection, as in Cases 1 and 2 where infectious discharge was absent, the stroma presents an entirely different picture. Case 4 shows very prettily in the area of chronic granulation tissue about the base of the tumor, the plasma cell infiltration of the vessel walls forming a parapet entirely surrounding or about one side of the vessels, as spoken of by Neuberger.

This type, "the benign fibrous polyps," histologically constitutes the analogue of the pure form of caruncle as found in the female. It is, probably, the most frequently occurring benign polyp of the male urethra, as is true of the simple caruncle in the female. They may occur, as these cases show, at any point along the urethral canal, nor do they show any preference as to the floor or the roof of the lumen for their situation. It will be seen that in these cases the occurrence of proliferating papillæ or even the suggestion of such is nowhere present. One of these cases denies venereal infection; all complained of some urethral discharge, except Case 2, whose growth was situated in the neighborhood of the colliculus, and here vague radiating pains and frequent nocturnal emissions replaced the annoying symptom of a urethral discharge. Growths in the posterior urethra, especially when about the colliculus, are almost invariably associated with sexual disturbances.

BENIGN VILLOUS POLYPS

CASE 5. No. 1493. Age 50. Admitted May 28, 1912. Has been treated elsewhere for a chronic urethral discharge and a "stricture," for the last two years. Complains of a "sensation" in the urethra, a mucoid discharge, and diminished sexual desire. *Endoscopy.* Posterior urethral walls are engorged. Colliculus is irregular and suggestive of some proliferative condition; it is hardly tender to the touch. Lightly curetted, and protargol application. Anterior urethra shows signs of old sounding, being sclerosed in places and the lumen cavernous.

June 10, 1912. Says he feels better and had an erection last night. *Endoscopy.* Piece removed from the irregular area as it suggests a polypoid proliferation. Silver nitrate application to the remainder.

June 17, 1912. Since the last treatment the patient has had a most successful coitus, "as of old," he says, with a good strong erection and organism. *Endoscopy.* For the first time the place from which the growth was removed is definitely oriented and the ragged point proven to be about one half of one cm. in front of (distalward to) the colliculus on floor of urethra, it is still slightly irregular and was touched with silver nitrate.

June 25, 1912. All symptoms are gone and the patient reports himself as well. *Endoscopy.* Area again proven distalward to a slightly sclerosed colliculus and is still rough and crater shaped, of about 5 x 5 mm. in extent. Cauterized.

It is often difficult in patients where the condition is associated, as so frequently is the case, with a marked congestion of the urethral walls, to pick up on the first endoscopy the normal landmarks of the posterior urethra, and here in this case I believe the colliculus was not seen at all at the first examination. This polyp measured approximately 9 mm. in length, arose from evidently a proliferating base, and appeared suggestive to the naked eye to be villous forming; i.e., papillomatous. The section (Fig. 4) comprises only a part of the growth and shows the more delicate villi formation.

Fig. 1. Case 1.

Case 6. No. 27. Age 26. Admitted Aug. 1, 1912. Gonorrhœa one year ago. Complains of pain suprapubically, slight frequency of urination, slight glassy discharge from the urethra. Urination otherwise normal, sexual power and intercourse normal. Glass No. 1 and No. 2 slightly cloudy. Prostate is quite indurated and very tender in the midline. Seminal vesicles are negative. Prostatic secretion shows about 25 per cent pus cells, also corpora amylacea and granule cells. *Endoscopy.* Colliculus enlarged, glary, sodden, and lustreless; œdema is marked, as is also tenderness. Silver nitrate application. Anterior urethra normal.

September 10, 1912. *Endoscopy.* Still having pains. Colliculus smaller, area about and above the utricular orifice is bilobular and pouting. Silver nitrate application.

October 1, 1912. *Endoscopy.* Posterior urethra about the same, colliculus a little smaller. Still having pains. Put on bi-weekly prostatic massage.

Fig. 3. Case 4.

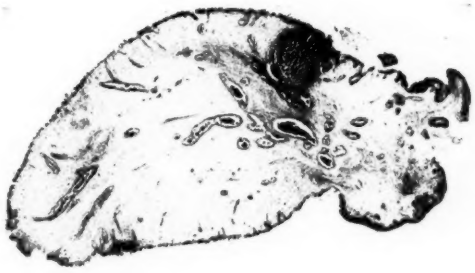

Fig. 2. Case 2.

November 12, 1912. Discharge gone, but is still having pains.

November 26, 1912. Slight return of discharge. Endoscopy and silver nitrate application.

December 17, 1912. *Endoscopy.* Colliculus as above. Iodine application.

January 29, 1913. Patient has been returning and getting prostatic massage fairly regularly. To-day states that the only relief that he has had from the pain was after the urethroscopic applications. *Endoscopy.* Back of the apex on the top of the colliculus is the bilobular protuberance above mentioned, appearing like two linked sausages. This was removed with the rongeur.

February 5, 1913. Has been free of pain for three days. *Endoscopy.* Colliculus is ragged and bleeds easily, but no protuberance visible. Silver nitrate application.

Fig. 4. Case 5.

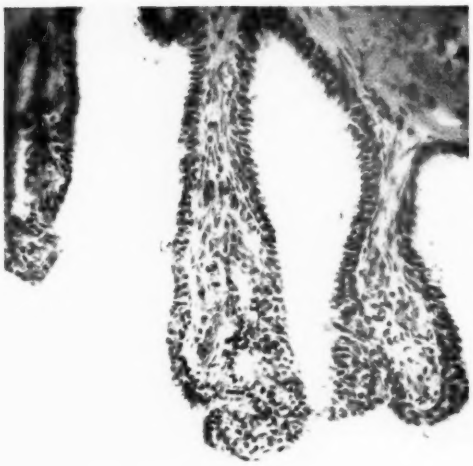

Fig. 5. Case 6.

February 12, 1913. Has been perfectly well and free of all pain for the past week.

Here the growth was not considered of importance, though seen and reported at the first endoscopy. It did not change in character and hardly in size during the entire period of treatment. Though the cauterizations seem to have had some effect in blunting the villi (Fig. 5), they have had but little in removing the actual tumor. The early, prompt, and permanent benefit obtained by complete removal in all these cases does not warrant the slow caustic, rubbing away (Oberlaender) or other temporizing methods, and frequently the relief from symptoms is synchronous with the complete removal of the irritating growth.

Remarks. Here we have the second type of urethral polyps, those which show papillary proliferation. The stroma appears to be similar to that found in the benign fibrous polyps, possibly in these specimens a little denser in character, yet loose, comparatively cell poor, and moderately vascular. The epithelial covering may be of two types. In Case 5 at the base one finds a many-layered epithelium, composed of densely packed cuboidal cells, which as one approaches the free end and the area of villous projections, gradually becomes transformed into a cylindrical epithelium and that which covers the villi is of only one or at the most two cells thick. Each villus has a definite connective tissue stroma and one or more engorged capillary vessels. Case 6 does not present such a clear cut picture. This patient did not have a pedunculated but a sessile protuberance, which was a little back of the apex of the colliculus, and it was probably not observed during many of the endoscopies because the tube was only placed as far as the distal end of the colliculus for cauterization. Also the villus projections undoubtedly suffered from the repeated applications of caustic silver, and we find the epithelium thickened to a many-layered coating paproaching the pavement type. However, though the specimen was rather chewed up in its removal, one can clearly make out (Fig. 5) the hypertrophying papillæ and the deep dipping in of the epithelium, and at the base may be seen a group of epithelial nests, (unfortunately cut in cross section and the central stroma having fallen out), which in all probability speak for more marked villous formation in this region.

These two cases representing the "benign villous polyps" both occurred in the posterior urethra, but one can not draw from this fact the conclusion that they are limited to this region. Other cases, some possibly much more typical of a papilloma, have been reported occurring in the anterior urethra (Briggs, Mark, Klotz, Fluss, Payenneville, and LeFur), while true venereal warts have been observed fairly frequently arising from the stratified epithelium of the fossa navicularis. Marion has recently reported a very typical case occurring in the posterior urethra back of the colliculus, while the classical work of Tarnowsky after showing the relative frequency in the anterior urethra says that "the bulb, the pars membranosa, and the pars prostatica not infrequently become the seat of pathologically developing papillæ." He also mentions several cases recorded at autopsy by such men as Civiale, Amussat, and Ricord, and specimens of similar conditions to be found in the various museums. As a matter of passing interest it appears that the celebrated surgeon von Layseau operated upon Henry the Fourth

about 1607 for a papillary vegetation of the urethra that was causing urinary obstruction. That all these reports and the many others that one finds in the literature are examples of histologically true papillomas one has to doubt, and I believe that subsequent microscopic study of such cases will put the true papilloma as the rarest of the three types of benign urethral polyps, though like the benign fibrous polyps, they may occur at any point along the urethral canal.

BENIGN GLANDULAR POLYPS

CASE 7.[1] No. 1913. Age 27. Admitted April 30, 1912. Complains of "impotence," due to premature ejaculation, and poor erections. Sexual excitement without gratification during a number of previous years. Denies venereal disease. Urination is normal. Subject to pains across the lower back. Prostate is quite indurated and adherent, its secretion contains a quantity of pus cells.

April 30, 1912. *Endoscopy.* On the apex of the colliculus is seen a prominently projecting polyp, standing upright and of fairly firm attachment and structure. It is situated a little to the right of the midline, about ½ cm. back of the mouth of the utricle, and is approximately 14 x 8 mm. in size. It was seized with an endoscopic rongeur and removed. Its point of attachment was cauterized with a silver nitrate stick. The remainder of the urethra is normal.

This specimen (Fig. 6) shows a slightly firmer type of connective tissue stroma, enclosing some muscle tissue, and is covered with a type of epithelium approaching in parts stratification, though mostly of closely packed cuboidal cells whose outer layer only consists of flattened cells. The surface is smooth and though everywhere along the edge there is distinct dipping inward of proliferating epithelium, it is not associated with the hypertrophy of any papillæ, but with a hyperplasia of the glandular structures. This is especially shown in the central part of the stroma of the distal half of the polyp which contains a score or more distended gland acini. The lumina of these acini are smooth and round, distended with a mucoid secretion, and are lined by one to three layers of epithelial cells, the innermost of which is of a high cylindrical type. There is no proliferation of the lining cells, simply a hyperplasia without hypertrophy of the glandular tissues of the growth. This high cylindrical epithelium of the acini appears to be undergoing a transgression to a more stratified type of cell, especially as the orifice of the duct is approached. This glandular proliferation is the distinctive characteristic of this type of polyp, and one could with all propriety classify them as adenomata. Following the removal of the polyp in this case the pains disappeared entirely, though (from a letter) the patient's sexual disturbances appear to be unimproved.

[1] I am indebted to Dr. A. B. Cecil, private assistant to Dr. H. H. Young, service of the Johns Hopkins Hospital, for the material composing this case.

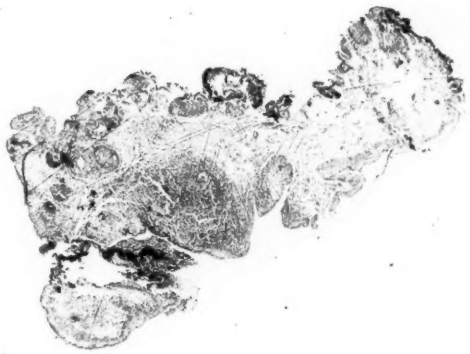

Fig. 6. Case 7.

CASE 8. No. 542. Age 30. Admitted Feb. 10, 1913. Gonorrhœa five years ago with a gradual subsidence of the acute symptoms, but the continuance of a morning discharge to the present day. Has occasional frequency of urination, no pain, no blood. Nocturnal emissions always twice a week, often twice per night, and sometimes three or four nights in succession. Before he had acquired gonorrhœa he would have a pollution once in three weeks, rarely oftener, and one year after the gonorrhœa was contracted he began having them more frequently, up until the present time. Glass No. 1 and No. 2 slightly cloudy (phosphates); prostate is small and not adherent, its secretion shows a few pus cells only in each field. *Endoscopy.* Colliculus normal in size and contour. Posterior urethral walls redden and bleed easily. One and a quarter centimeters in front of the colliculus and arising from the five o'clock aspect of the urethral lumen is a mushroom polypoid growth, low-lying and fairly well fixed. Excised with a curette and base cauterized.

February 28, 1913. *Endoscopy.* Scar where growth was removed is one cm. in front of the colliculus, the latter is in good condition. Anterior urethra is speckled with lenticular shaped brown spots, especially along the roof of the urethra; they are undoubtedly infected glands, stained from

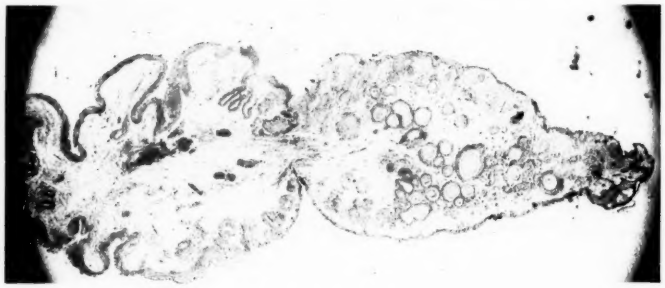

Fig. 7. Case 8.

the prolonged use of protargol. Some still exude a small droplet of purulent material.

March 6, 1913. *Endoscopy.* Has not had an emission during the past three weeks. Has had no pain except a slight burning during urination. On examination, site of excision and the colliculus are normal, slight excretion of prostatic fluid (showing normal elements) into the tube.

Unfortunately the first bite of the rongeur in this case removed the apex of the growth only, and somewhat spoiled the specimen. It is a second specimen of glandular polyp and here (Fig. 7) the glandular tissue is slightly more redundant and hypertrophic than in the previous case, where the glands seemed to be simply distended. Here as one runs through the serial sections, one finds quite definite proliferative projections into the lumen of the acini from the hypertrophying cylindrical epithelium. It gives all the characteristics of a mucous gland and undoubtedly arose from one of the glands of the mucosa, probably irritated by infection, as in this patient the glands all along the urethra appeared to be especially involved.

Since the removal of the growth the frequency of urination and the nocturnal emissions have entirely disappeared. There is still some slight discharge kept up by the glands of the anterior urethra, for which the patient is receiving appropriate endoscopic treatment.

Case 9. No. 166. Age 30. Admitted Sept. 18, 1912. Denies venereal disease. Complains of a pale, glassy urethral discharge in the morning, of nine months duration. Two months age he passed some blood at the end of an act of urination. Has several prepucial warts. Prostate is normal on rectal examination and its secretion is also normal. Glass No. 1 contains a few mucoid shreds; No. 2 is clear. Bulbous bougie finds no stricture in the anterior urethra. Cystoscopy attempted but profuse bleeding renders observation impossible.

September 24, 1912. *Endoscopy.* Anterior urethra is normal. Posterior urethra is highly congested and the landmarks are difficult to observe. Colliculus does not appear enlarged, but everything is intensely engorged and bleeds on the slightest touch. Silver nitrate application.

September 30, 1912. *Endoscopy.* Condition about the same. Colliculus appears ragged. Silver nitrate application.

October 11, 1912. *Endoscopy.* After swabbing the posterior urethra with 20 per cent silver nitrate, the landmarks could be made out for the first time. A polyp could be observed situated about one cm. distalward from the colliculus, arising from the floor of the urethra in the midline; it is approximately 8 x 6 x 4 mm. in size; it was removed with a rongeur and the base not treated. External warts fulgerized.

October 15, 1912. *Endoscopy.* Area from which the tumor was removed is slightly œdematous and about one cm. distal to the colliculus; it is healing nicely and nothing done to it. External warts have vanished.

Remarks. The presence of such gland-containing polyps in the male urethra affords many interesting points for consideration. Such cases have been reported by but three other observers. Burckhardt records five such cases, two of which had never had gonorrhœal infection, and he considers his cases to be mucous glands, undergoing adenomatous change, and similar to the mucous polyps of the nose. Two of his cases arose from the colliculus itself: as in Case 7 of my series, Case 5 of his was a central growth arising from the floor of the urethra, and apparently it was similar in its macroscopic appearance and description to my Case 9. He says that on microscopic section they present "a many-layered epithelial surface

Fig. 8. Case 9.

enclosing a loose connective tissue in which are found cell rich mucous glands. On cross section (the glands) show extreme invagination of the walls and are covered with a single layer of cylindrical cells." Wechselmann's case was a post-gonorrhœic; the section showed "an adenomatous structure with a papillary surface, with small cell infiltration and a strong vascular connective tissue." The illustration accompanying this report showed typical glandular areas (without any marked invaginating of the walls of the lumen), but with no papillary proliferations on the surface of the tumor; it is without doubt a true polyp of the type with which we are dealing. Lydston's patient was undergoing a perineal boutoniere operation, when Lydston found "in front of the triangular ligament" a tumor, which the author is of the opinion arose from the right Cowper's gland and adds that: "In perineal operations upon young adults I have found in a number of instances small adenomatous growths beneath the mucous membrane of the prostatic urethra, and encroaching to a greater or less extent upon the caliber of the canal." He has in every instance found them of the same histological structure as above and considers them prostatic adenomata in their incipiency. These are the only three references to such growths in the male urethra to be found in the literature, with the possible exception of a supposedly similar case reported by Lemoine and mentioned by Ousset, which references unfortunately I have been unable to acquire.

So it remains for us to determine from what anatomical structures such glandular growths may gain their origin, whether from the glands of the urethra or whether it represents true hypertrophic prostatic glandular tissue. It is known that glands occur in the prostatic urethral mucous membrane and according to Delbet they are the glands of Littre. They have a more perpendicular course and penetrate as deep as, often into, the muscle tissue underlying the chorion of the mucosa. They are composed of a thin membrane propia and a layer of cylindrical cells. On the other hand we are assured by Motz, Moullin, Lydston, Griffith and others, that there is frequently detached prostatic glandular tissue situated close under the floor of the urethra, whose ducts can be found opening into the urethra, frequently behind the colliculus and occasionally in front of it. Moullin says: "Usually there are a few isolated glands in the median line behind, with ducts that open into the urethra between the posterior end of the verumontanum and the vesical outlet; more rarely a few are to be found in front as well."

Delbet is equivocal, saying: "The orifices of the prostatic ducts come out all about the posterior urethra in the part subjacent to the sphincter, but occupy the posterior and lateral part; they are missing, some say, in the median line anteriorly." Lowsley in a recent embryological study says that in one of the cases which he studied "the posterior lobe is made up of eleven tubules which open on the floor of the prostatic urethra anteriorward from the entrance of the ejaculatory ducts, and grow back towards the bladder behind these structures, forming the main mass of the apex of the gland." Moullin states that hypertrophy of the prostate may make its first appearance in the submucous layer of the urethra and Motz claims that hypertrophy practically always begins in the glands close to the urethra."

The glandular tissue in the first two specimens is composed of tubules of generous size lined by an epithelium of from one to two cells thick, the innermost of which is of the high columnar type of cell with the nucleus placed well towards the base of the cells. There is a definite basement membrane and in some sections a moderate amount of infolding and papillomatous projection into the lumen of the acini, some of which invaginations are of only epithelial cells; others, evidently of older origin, carry with them a definite connective tissue stroma. That such adenomatous change may, and probably does, have its origin from the glands of the urethral mucous membrane, seems to be the most reasonable answer for such a picture as we find in these two cases. The polyp in Case 7 arose from the colliculus, where similar glandular structures occur in the mucous membrane as are found elsewhere in the urethral mucosa, and from which the growth in Case 8 also undoubtedly arose.

The specimen of Case 9 (Fig. 8) shows a much greater tendency towards active hypertrophy, the picture being entirely different, the infolding very marked, the stroma purely a supportive connective tissue, while certain of the acini are greatly dilated, and covered with a flattened epithelium, giving in all a picture so familiar in benign prostatic hypertrophy. The line of demarcation, irrespective of the embryological origin, between the glands of the urethral mucous membrane, the glandular structures of the colliculus and those of the prostatic lobes is very hard of differentiation. Delbet says that the glands of the colliculus are of the same structure as those of the prostatic lobes. In this specimen from Case 9 is a picture which is indeed close upon the borderline and it is in fact impossible to say absolutely what glandular elements and tissue were the parent stock from which it arose. If it is a submucous gland in origin the degree of hypertrophy is enormous and almost sufficient, in comparison with such simple structures as are found in Cases 7 and 8, as to warrant the fear of malignancy, potential if not yet actual. As compared with the usual picture of benign prostatic hypertrophy one has to confess that the lumina are smaller, the trabeculæ are finer, the whole picture and the general architecture is more delicate and suggestive of recent activity of development. Yet one must remember at the same time that this grew freely from the surface into a spacious lumen and was not compressed as the ordinary hypertrophic prostatic acini would be within a tense capsule; moreover, it occurred in a relatively young man, and from the duration of the symptoms may be considered of very recent growth, all of which would make allowance for the slight atypical character of the microscopic picture from that which we are used to consider as benign prostatic hypertrophy, as it occurs in elderly men. The growth itself classified simply from the microscopic picture, apart from its origin or location, is a papillary cystic adenoma, and I feel justified in considering it as in all probability prostatic in its origin, and representing early benign hypertrophy possibly in a tuft of aberrant prostatic tissue, possibly from such a spheroid as Lydston says he has frequently seen, possibly from a normal prostatic gland tubule; but with the latter possibility arises the fact that to be such it must be hypertrophy of the post-spermatic prostatic tissue, which as we know, has been shown to rarely undergo hypertrophic change of a benign character. Whatever its origin it cannot but be of intense interest when realizing its important bearing on the unsolved problem of the etiology of

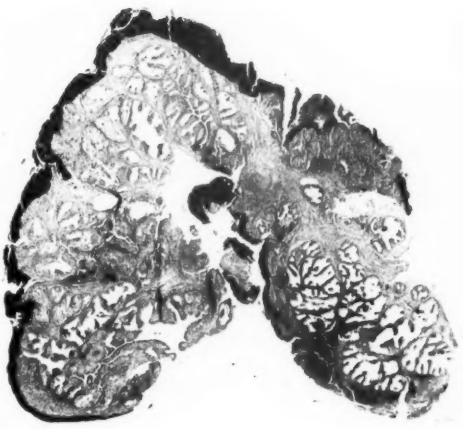

Fig. 9. Case 9.

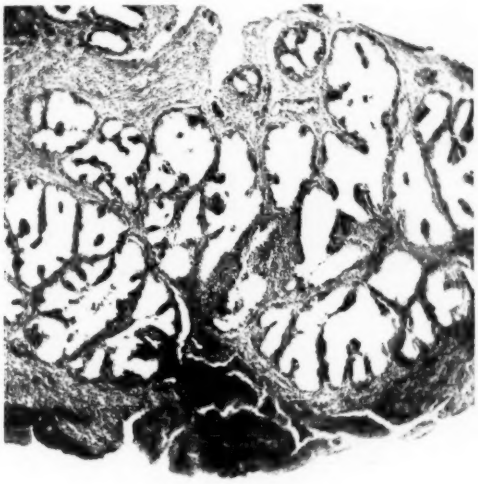

Fig. 10. Case 9.

the prostatic enlargement. One other feature of interest in this case is that it arose in the urethra of a man who denied previous gonorrhœal infection, excluding such from having any etiological bearing.

Symptomatology. This varies with the location of the growth and with the type of patient in whom it occurs. The most prevalent complaint is that of a chronic urethral discharge or the repeated re-occurrence of a discharge. The occurrence of disturbances in the sexual sphere when the growth is located in the posterior urethra are likewise prevalent, and it is to be feared that many of those poor creatures who wander from physician to physician, from dispensary to dispensary, seeking relief, until the power of a quack falls on him and robs him of his last mite, and he becomes a sexual derelict, have some such condition in either the anterior or the posterior urethra. It is to be expected that such a growth must act and feel as a foreign body would, irritating the sensitive colliculus until pollution follows pollution, annoying the patient with vague reflex pains until he is neurotic, or keeping up a urethral discharge which makes him shun intercourse and fear matrimony, until life itself becomes a burden. Three of these patients denied previous gonorrhœal infection, and in one other the history failed to state this point. It is peculiar and to be noted that only one case of this series gave a history of urethral bleeding (No. 9). Pain during urination, and referred pains to the glans, the suprapubic region, the perineum, and the back, are frequent, while two of the patients had a definite sensation as of something lying in the urethra (Cases 1 and 5).

As the use of the endoscope becomes more general, it is to be expected that the ratio of the occurrence of urethral polyps in the male will correspondingly increase, and to-day one should no more attempt the treatment of a case of chronic urethral discharge without the endoscope than he would an acute urethritis without the microscope.

NOTE: Since the preparation of this paper I have encountered still another case of benign glandular polyp, histologically similar to that of Case 9. This recent specimen occurred in a post-gonorrhœal urethra and grew from the interior of the prostatic utricle outward, stretching the utricular orifice into a rigid ring about a protruding waxy proliferation, giving a picture closely resembling, in its symmetry and proportion, an acorn in its jacket.

The growth was quite friable and was easily and completely removed with the rongeur.

Microscopically it presents an actively proliferating glandular hypertrophy with a sparse connective tissue stroma. The acini

are lined with high cylindrical epithelium. Papillomatous invagination of the glandular lumen is marked.

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SURGERY OF THE ILEOCÆCAL VALVE

A Method of Repairing an Incompetent Ileocæcal Valve and a Method of Constructing an Artificial Ileocolic Valve

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THE ileocæcal valve has been known to anatomists for more than three hundred years, but its function has been so little appreciated that it has been almost altogether neglected, and up to the present time its structure has been almost wholly ignored by surgeons in the operation of ileosigmoidostomy and other surgical procedures in which the small intestine has been separated from its normal connection with the cæcum and joined to the colon at some other point. No attempt has been made to reconstruct the valve or to devise any means for preventing reflux of fæces from the colon into the small intestine. The function of the ileocæcal valve has evidently been regarded as of so little consequence that it might be ignored.

In another paper the writer has undertaken to summarize the facts which have been developed in recent years respecting the functions of the ileocæcal valve and the pathological effects which result from its absence or incompetency. These facts may be briefly summarized as follows:

Bauhin, Tulpius, and other of the early anatomists showed that the ileocæcal valve is a most efficient mechanical contrivance for preventing reflux of gas or liquid from the colon into the small intestine. John Mason Good observed that in addition to its mechanical structure the ileocæcal valve possesses also a muscular function capable of acting as a sphincter. Elliott demonstrated in 1904 that the valve behaves as a true sphincter in the dog, possessing like the pylorus a special nervous mechanism distinct from other parts of the alimentary canal. Sir William Macewen recorded the results of observations made upon a case in which as the result of the destruction of a portion of the anterior wall of the cæcum it was possible to watch the action of the ileocæcal valve and a reciprocal activity of the appendix.

Case, Cannon, and others, who have made a systematic study of the alimentary canal by the aid of the X-ray and the bismuth meal, have demonstrated that the ileocæcal valve not only prevents reflux of material from the colon into the small intestine but also regulates the movement of material from the small intestine into the colon in a manner quite analogous to the action of the pylorus in passing digesting food from the stomach into the small intestine.

That these functions of the ileocæcal valve must be highly important to the welfare of the body is a necessary inference from the fact that the structure is present in practically all vertebrate animals above the level of amphioxus. The pylorus and the ileocæcal valve divide the alimentary canal into three parts, the functions of which differ in such a way as to require their isolation. These are known to anatomists as the fore-gut, reaching from the mouth to the pylorus; the mid-gut, the small intestine, extending from the pylorus to the ileocæcal valve; and the end-gut, the large intestine. When, as the result of disease, reflux from the small intestine into the stomach occurs, the result is nausea, vomiting and serious interference with the functions of the stomach.

The possible injury from reflux of material from the colon into the small intestine seems to have been quite generally overlooked. In another paper the writer has summarized the results of observations in some sixty cases, in which the ileocæcal valve was incompetent, which seem to show a clear relation between incompetency of the ileocæcal valve and a distinct group of pathologic conditions. In the paper referred to the writer has detailed a variety of non-surgical methods which have been found of very great service as a means of mitigating, and in many cases almost wholly relieving, the ill effects resulting from an incompetent ileocæcal valve. The chief pur-

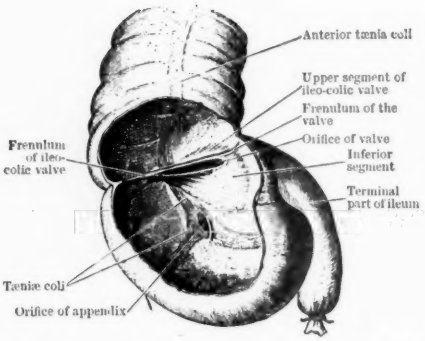

Fig. 1. Ileocæcal valve viewed from the interior of the cæcum (Cunningham).

pose of this paper is to point out a method by which an efficient ileocolic valve may be constructed in cases in which this important structure has been destroyed by disease or is necessarily sacrificed by surgical procedure. A method will also be described by which an incompetent ileocæcal valve may be repaired and rendered competent.

As usually performed, the operation of ileosigmoidostomy leaves the ileum with no protection against the reflux of fæcal matters from the colon. Through this backing up of fæcal matters the small intestine, by dilatation may in time present as large a storage chamber as did the colon before the operation. On one occasion the writer

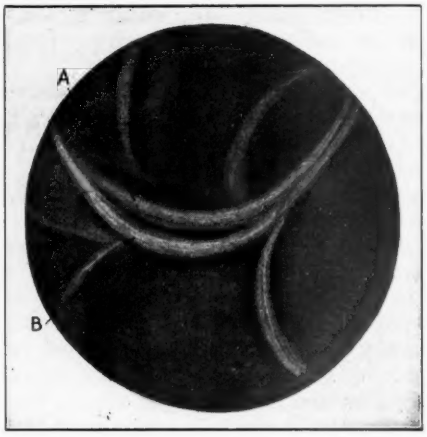

Fig. 2. Ileocæcal valve closed (Kraus).

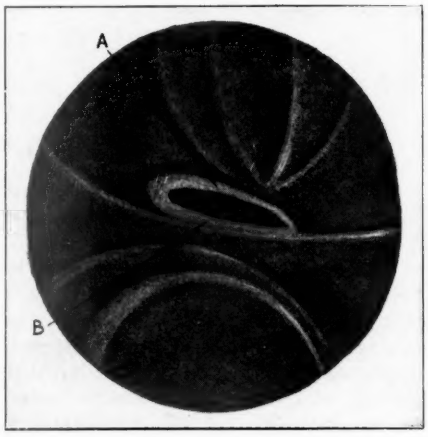

Fig. 3. Ileocæcal valve open (Kraus).

was present at an operation performed upon a patient who had previously undergone the operation of ileosigmoidostomy at the hands of a good surgeon but who was suffering as badly as before the operation, so that a second operation had become necessary. When the abdomen was opened, many adhesions were found present and the small intestine was so greatly distended that for some distance from the point of junction with the colon it was fully as large as a normal colon. It is evident that when the small intestine is deprived of the protection against reflux with which nature provides it, the mid-gut may readily become the seat of pronounced stasis with all the evil consequences which result from this condition. All these difficulties and dangers may be obviated by the construction of a valve, when it becomes necessary to abandon the normal ileocolic junction and form a new one.

First, it is necessary to briefly consider the structure of the normal valve. Cunningham gives the following excellent description of the ileocæcal valve as found in human beings:

"Where the ileum enters the large intestine the end of the small gut is, as it were, thrust through the wall of the large bowel, carrying with it certain layers of that wall, which project into the cæcum in the form of two folds, lying respectively above and below its orifice, and constituting the two segments of the

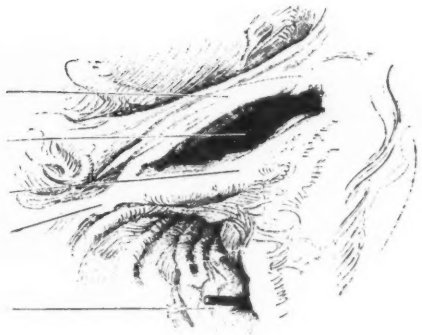

Fig. 4. Ileocæcal valve, common form (Cunningham).

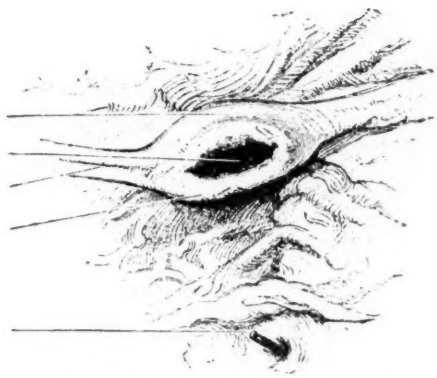

Fig. 5. Ileocæcal valve, circular form (Cunningham).

ileocæcal valve (Fig. 1). The condition may be compared to a partial inversion or telescoping of the small into the large intestine; it must be added that the peritoneum and longitudinal muscular fibers of the bowel take no part in this infolding; on the contrary, they are stretched tightly across the crease produced on the exterior by the inversion, and thus serve to preserve the fold and the formation of the valve.

"As seen from the interior, in the specimens which have been distended and dried (Fig. 2), the valve is made up of two crescentic segments—an upper, in a more or less horizontal plane, forming the superior margin of the aperture; and a lower, which is also larger, placed in an oblique plane, and sloping upward and inward (i. e., toward the cavity of the cæcum). Between the two segments is situated the slit-shaped opening, which runs in an almost anteroposterior direction, with a rounded anterior and a pointed posterior extremity (Fig.3). At each end of the orifice the two segments of the valve meet, unite, and are then prolonged around the wall of the cavity as two prominent folds — the frenula (frenula valvulæ coli). It is thought that when the cæcum is distended, and its circumference thereby increased, these frenula are put on the stretch, and, pulling upon the two segments of the valve, they bring them into apposition, and effect the closure of the orifice.

"In bodies hardened *in situ* with formalin, the valve and orifice present an entirely different appearance (Figs. 4 to 6, in which three different forms of hardened valves are shown), suggesting, much more closely than in the dried state, the appearance of telescoping or inversion mentioned above. In them also the two segments of the valve are much thicker and shorter, but they can always be distinguished, and are found to bear the same relation to one another as in the dried condition, although this may be obscured by foldings or rugæ. The aperture may be slit-like or rounded, with sloping or infundibuliform edges; the frenula are not so prominent at times; but the whole valve projects much more abruptly into the cavity of the cæcum than in the distended and dried specimen.

"Each segment of the valve is formed of an infolding of all the coats of the gut, except the peritoneum and the longitudinal muscular fibers, and consequently it consists of two

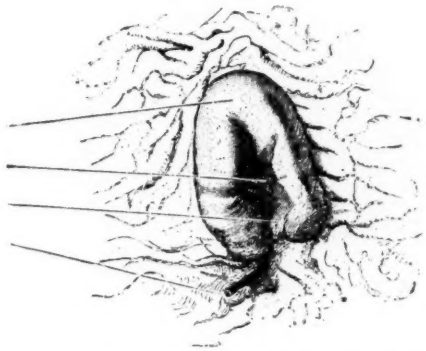

Fig. 6. Ileocæcal valve, imperfect form (Cunningham).

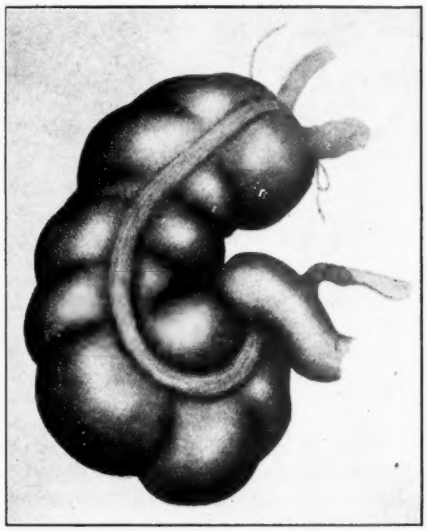

Fig. 7. Cæcum, ascending colon and terminal ileum, showing ileocolic junction.

layers of mucous membrane, with the submucosa and the circular muscular fibers between, all of which are continuous with those of the ileum on the one hand and of the large intestine on the other. The surface of each segment turned toward the small intestine is covered with villi, and conforms in the structure of its mucous membrane to that of the ileum; while the mucous membrane of the opposite side resembles the mucous coat of the large bowel.

"In the dried specimen the upper segment projects further into the cavity of the cæcum than the lower, so that the aperture appears to be placed between the edge of the lower segment and the under surface of the upper.

"There is little doubt, as pointed out by Symington, that the efficiency of the ileocæcal valve is largely due to the oblique manner in which the ileum enters or invaginates the cæcum; this oblique passage alone, as in the case of the ureter piercing the wall of the bladder, would probably be sufficient to prevent a return of the cæcal contents. In the great majority of cases, when in position with the body, the ileum is perfectly protected from such a return, although when the parts are removed, and then distended with fluid, this often passes through the valve, and reaches the small intestine. Still, the efficiency of such a test, applied when the parts are deprived of their natural supports, cannot be relied upon.

"The size of the segments of the valve, as seen in the dried condition, varies considerably; they are sometimes very imperfect and even the absence of both has been recorded. But here again there is danger of falling into error, through examining the parts under such artificial conditions."

It thus appears that the ileocæcal valve is in the human subject ordinarily a buttonhole-like aperture, although it may also have a different appearance, as shown in Fig. 5, a form which is frequently found in human beings and is the usual form in the dog and the pig.

A clear understanding of the mode of construction of the valve may be obtained by careful study of Figs. 7 to 11. First of all, it is to be noted that the pouch of the cæcum does not lie in a vertical line with the lumen of the ascending colon. In man and the higher apes

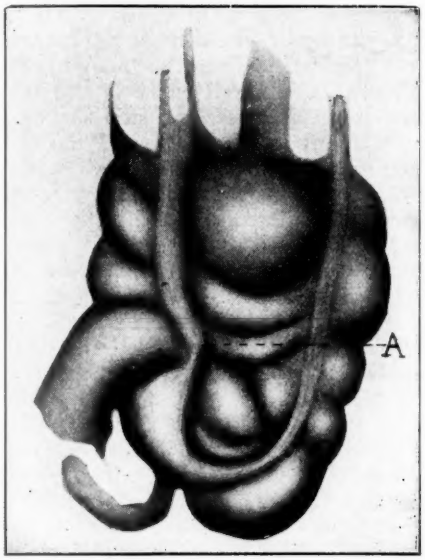

Fig. 8. Same as Fig. 7, bowel rotated outward, showing habenula, A.

the cæcum is strongly curved inward. This is well shown in Fig. 12, which represents the cæcum and ileocolic junction of the chimpanzee. The evident purpose of the curve in the gut at this point is to infold the ileocolic junction and to cause it to project into the lumen of the colon as shown in Fig. 9.

By rotating the colon outward, as shown in Fig. 8, it will be seen that a narrow muscular band passes just behind the ileocolic junction. This has been called by German anatomists the habenula. It serves to pucker the gut, forming several small haustra, which infold the end of the ileum, and carry into the lumen of the colon the point of junction between the ileum and the corresponding structures of the colon. A division or stretching of this band causes an unfolding of the intestine and more or less complete disappearance of the haustra contiguous to the ileocolic junction and damage to the ileocæcal valve, which may be rendered partially or completely incompetent. If the peritoneal and outer muscular coats are stretched or divided at the ileocolic junction, the ileum may be pulled out of the large gut

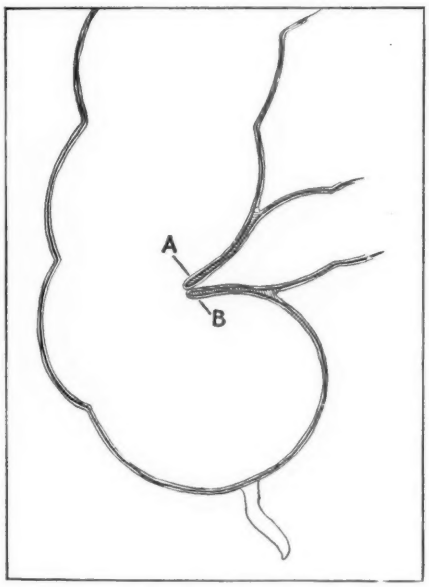

Fig. 9. Diagram, showing structure of ileocæcal valve, intussusception of small intestine forming anterior and posterior lips, A, B.

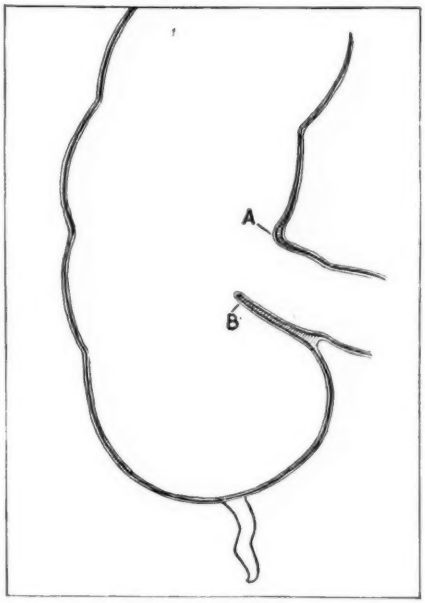

Fig. 10 Partially incompetent ileocæcal valve, anterior lip damaged by over-distention of the colon.

and the valves disappear, leaving a large funnel-shaped opening instead of a buttonhole opening guarded by overlapping lips.

The appearance of the gut produced by rupture of the habenula or stretching of the serous and outer muscular coats is shown in Figs. 13 and 14. Fig. 13 shows the condition most commonly found present. I have noted the condition shown in Fig. 14, in which the habenula is ruptured, in two cases. In one of these the point at which the muscular band had broken off at its lower insertion was very distinct. This accident must be the result of some very violent and comparatively sudden distention of the gut.

In numerous cases in which I have had an opportunity during operation to examine the ileocæcal junction, after an X-ray examination in which the valve had been found to be incompetent, I have found the funnel-shaped opening described above and the appearance shown in Fig. 13. In these cases the form of the colon is changed. The curve of the lower portion of the gut is lost. The haustra contiguous to the ileocolic junction have dis-

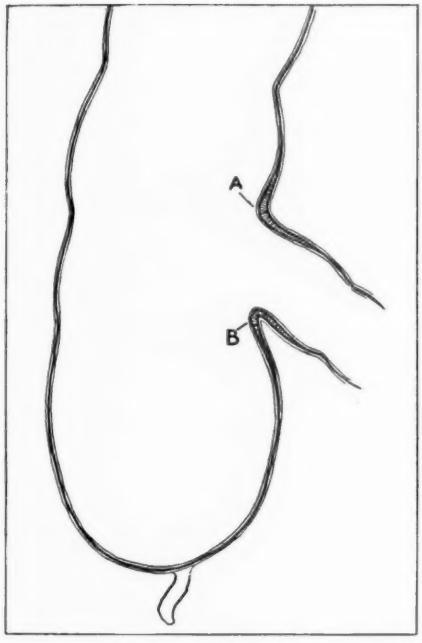

Fig. 11. Completely incompetent ileocæcal valve, both lips destroyed by over-stretching of the gut.

appeared, and evidence of incompetency may be easily obtained by making the gas and liquid present in the cæcum pass back into the ileum by the application of slight pressure. By compressing the ascending colon and then making light pressure upon the cæcum, the ileum, previously emptied, will be instantly distended. The movement of gas or liquid from the colon into the ileum may be accompanied by a slight sound, or, when the opening is very large, no sound may be heard. By this simple method the competency of the ileocæcal valve may be tested at any time when the abdomen is opened for removal of the appendix or other operation in the lower abdomen.

I am firmly convinced that incompetency of the ileocæcal valve is a serious cause of disease and that the matter is one of sufficient importance to deserve surgical attention. I do not, however, advocate the opening of the abdominal cavity solely for the purpose of repairing an incompetent ileocæcal valve, although it is possible that such a procedure may in some cases be justified. But it does seem to me to be the duty of the abdominal surgeon to make a careful examination of this structure and when the valve is found seriously incompetent to repair it by a simple procedure which I shall describe or some other method by which the same result may be obtained.

Figs. 9 to 11 show diagrammatically the condition of the ileocæcal valve in health and disease. Fig. 9 shows a normal valve in which the two lips composing the valve are shown at A and B. Fig. 10 shows a valve incompetent because of longitudinal stretching of the ascending colon which has destroyed the upper lip of the valve shown in A. Fig. 11 illustrates a case in which the cæcum and colon have been so greatly stretched that both lips of the valve have been destroyed. Of course the ileocæcal valve may be rendered incompetent by other causes than simply stretching of the gut and resulting unfolding of the valve lips. They may become attenuated by degeneration of the mucous and muscular tunics to such a degree that the valve ceases to be effective in preventing regurgitation into the ileum. The valve may also be destroyed by tubercular disease or by simple ulceration. I believe, however, that destruction of the lips of the valve by long overstretching of the gut is by far the most common cause of incompetency. The position

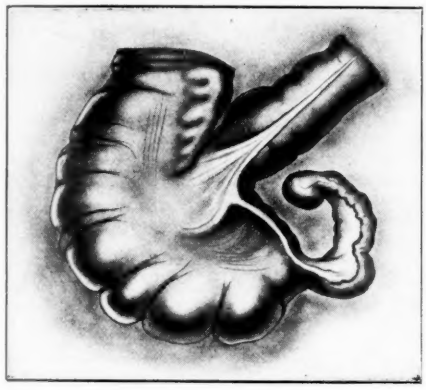

Fig. 12. Cæcum and terminal ileum of the chimpanzee.

of the valve opening, lying as it does crosswise of the gut, renders it specially liable to damage by stretching of the colon and cæcum in the long axis of the gut.

METHOD FOR REPAIR OF AN INCOMPETENT ILEOCŒCAL VALVE

The procedure is simply an attempt to restore the valve as nearly as possible to its normal condition. The method of accomplishing this will be readily understood by reference to the accompanying cuts, Figs. 15 to 31.

First of all, the bowel is rotated upward so as to bring the under side of the ileocolic junction into view. The usual normal appearance of the parts is shown in Fig. 8. Supposing the case to be one in which the habenula has been ruptured as shown in Fig. 13, the first step is to insert a suture through the seromuscular coats of the colon and the ileum at such points as will cause a slight intussusception of the ileum (Fig. 15). The suture is then tied (Fig. 16). Next a suture is passed through the separated ends of the ruptured habenula (Fig. 17). When the suture is tied and the ends cut, the opening will be narrowed and the intussusception of the gut will be restored (Fig. 18). The operation may be done with a single linen or silk suture placed as shown in Fig. 19.

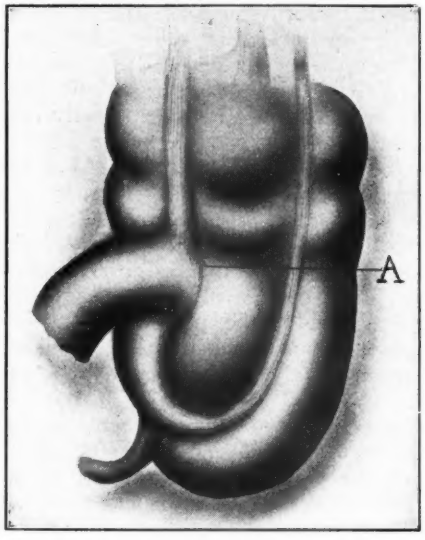

Fig. 13. External appearance of the ileocolic junction showing ileocæcal valve rendered incompetent by rupture of the habenula (redrawn from Kraus).

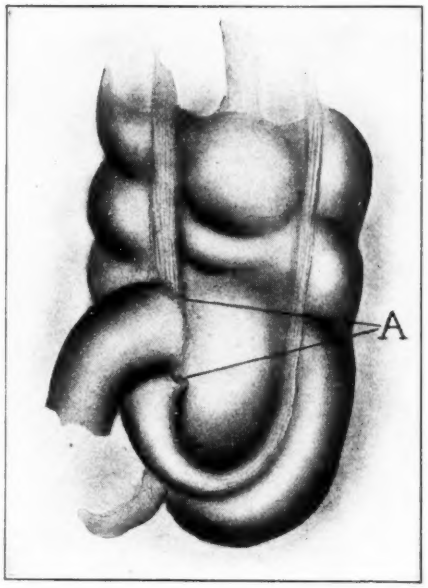

Fig. 14. External appearance of ileocolic junction with incompetent ileocæcal valve, A, due to over-stretching of habenula.

When the suture is tied, one side of the intestine is invaginated into the colon and the size of the enlarged opening is reduced. I find the single suture method to be on the whole the most satisfactory.

Firm adhesion of the surfaces thus brought together is secured by abrading the peritoneum or painting it with tincture of iodine.

In the great majority of cases this is all that is required to completely restore the competency of the valve. In some cases, however, in which the bowel has been greatly dilated and elongated, both lips of the valve are destroyed and it is then necessary to suture the opposite side of the junction. Care must of course be taken to avoid narrowing the opening too greatly. The size of the opening may be tested by grasping the valve with the thumb and finger through the walls of the ileum and colon. The competency

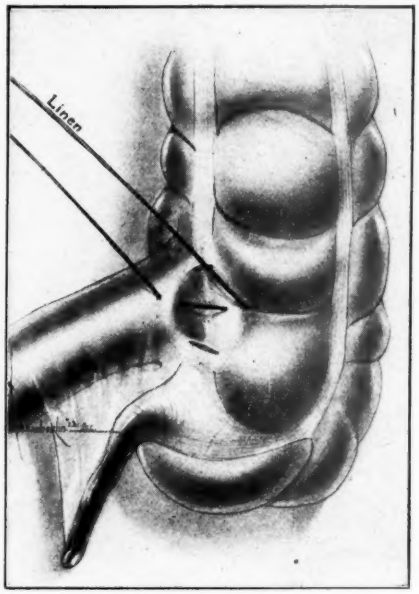

Fig. 15. First step in repair of incompetent ileocæcal valve. Suture placed to restore posterior lip.

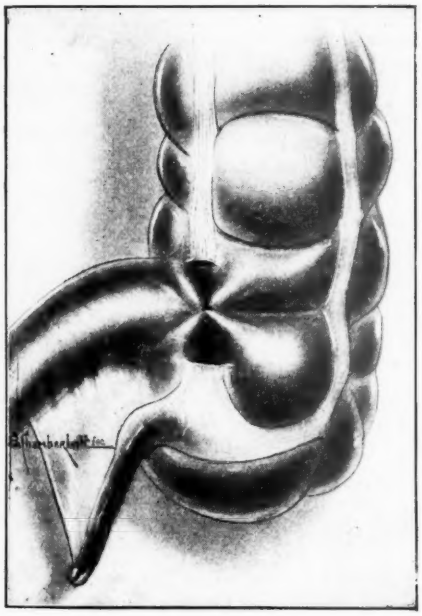

Fig. 16. Suture tied.

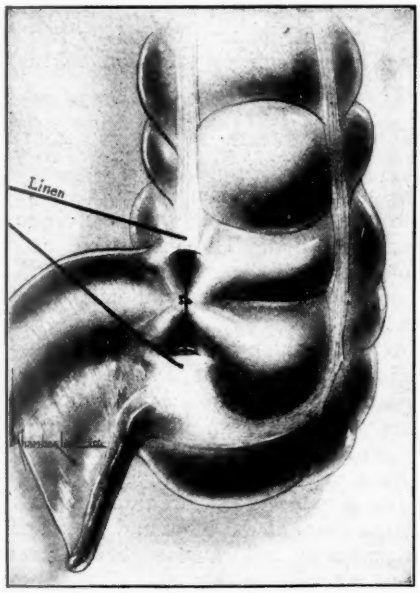

Fig. 17. Second suture placed to approximate ends of the torn habenula.

of the valve may be proved by stripping the ileum toward the colon and then compressing the ascending colon and making pressure upon the cæcum so as to cause reflux if the valve is still incompetent. When the repair of the valve has been properly done, gas and liquid will pass easily from the small intestine into the colon but will not pass backward into the small intestine even when considerable pressure is made upon the cæcum.

I have performed this operation in thirty cases (June, 1913), with satisfactory results. Examination after the operation by Dr. Case, röntgenologist of the institution, has shown the repaired valve to be competent in each case.

Necessarily, good judgment must be exercised to avoid producing too great narrowing of the valve and obstruction. In all cases in which the operation has been done the small intestine appears to perform its function in a perfectly normal manner.

Dr. J. Walter Seawell of Healdsburg, Cal., recently told me of a case in which the colon

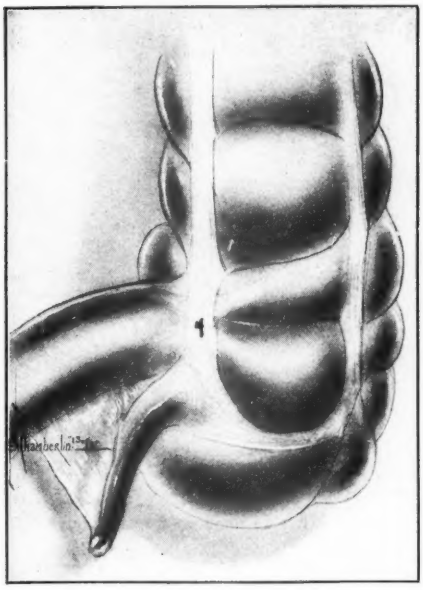

Fig. 18. Suture tied. Repair of valve completed.

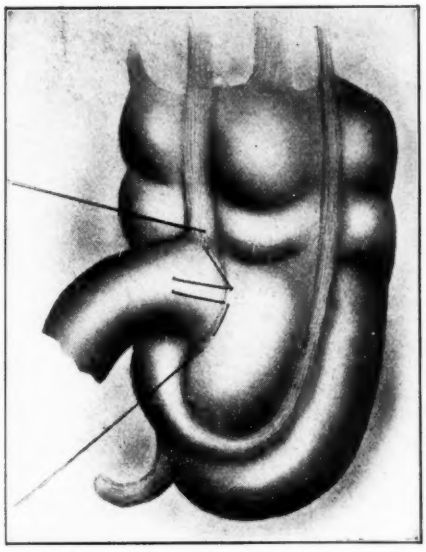

Fig. 19. Method of repairing valve by means of a single suture.

was removed by Dr. Wallace I. Terry of San Francisco, and in which death occurred four months after the operation from cholangeitis and cholecystitis, the result of infection which traveled up from the colon through the ileum. Such an infection must be greatly facilitated by the absence of a valve at the ileocolic junction.

It is of course necessary that the patient should, after operation for repair of the ileocæcal valve, receive such instruction as will enable him to avoid the causes likely to induce a return of the difficulty, as it is conceivably possible that the incompetency may be reproduced, although as yet I have seen no case of relapse.

METHOD OF CONSTRUCTING AN ILEOCOLIC VALVE

In the writer's experience most cases of chronic constipation are curable by proper regulation of diet and the application of other physiologic means, but a certain proportion of cases resist all such measures, intestinal stasis persisting in spite of the most thoroughgoing application of remedies.

The remarkable advances made in the technique of the X-ray study of the alimentary tract within the last few years have rendered

Fig. 20. Artificial ileocolic valve.

Fig. 21. Ileocæcal valve of a dog.

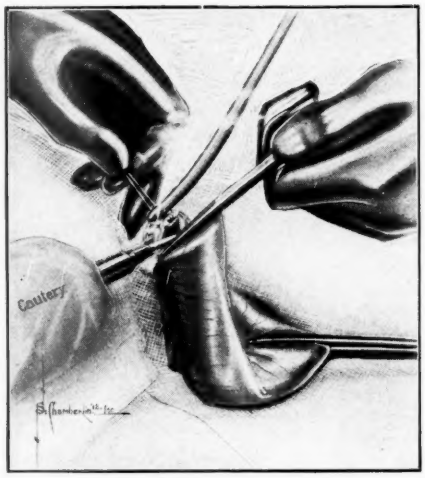

Fig. 22. First step in operation of short circuiting the colon and of making an artificial ileocolic valve. Division of the ileum.

invaluable service in making it possible to locate the cause of obstruction in these obstinate cases.

The remarkable results which Mr. Lane of London has obtained by his operation of ileosigmoidostomy, under the guidance of X-ray findings, have furnished the most convincing evidence that stasis in the colon is responsible for a large number of grave chronic disorders which have heretofore been attributed to other causes. Mr. Lane's experience has further demonstrated that these conditions are entirely curable by the elimination of colonic stasis either by removal of the colon or by the short circuiting operation.

Notwithstanding the excellent results demonstrated by Mr. Lane and verified in a number of cases by his own experience, the writer has from the first felt misgivings respecting the permanent results of the operation because of the elimination of the ileocæcal valve. In the first case in which I performed this operation, seven years ago, the results were extraordinarily good. Scores of cases have been reported not merely by Mr. Lane but by other surgeons in which most excellent results have followed the operation; but good results have been by no means uniform. On one occasion, the writer witnessed a second operation by a prominent surgeon for relief of adhesions in a case in which the larger part of the colon had previously been removed and a junction made between the ileum and the pelvic colon. In this case the ileum had become distended to nearly the size of a normal colon. It was evident that the small intestine had been distended by backing up of material from the colon, and it may be easily believed that the infection of the small intestine resulting from such reflux may have been the cause of the very extensive adhesions which were present and which had become the cause of obstruction necessitating a second operation. A study of the structure of the ileocæcal valve and its functions confirmed me in the belief that the natural barrier which nature has erected in all vertebrate animals between the putrefying waste materials of the colon and the foodstuffs undergoing digestion and absorption in the small intestine is a condition necessary for the maintenance of the structural and functional integrity of the mid-gut and of the organism. I accordingly determined that in the next case in which I was called upon to form a new junction between the ileum and the colon I would undertake to make some kind of a valve capable of preventing reflux. A study of the ileocæcal

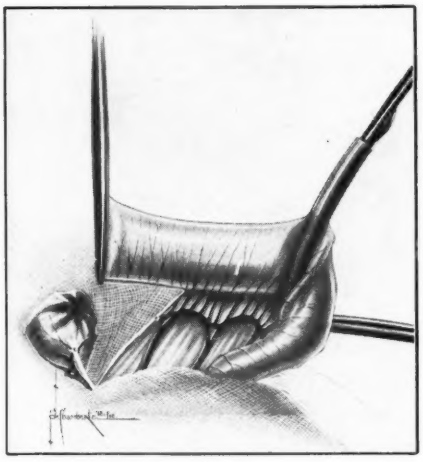

Fig. 23. Second step; mesentery separated from end of ileum.

valve of the pig and later of the dog showed me that an efficient valve may be produced by simple intussusception of the ileum into the large intestine. Having constructed such a valve I found that it worked perfectly. It was possible to inflate the colon through the ileum and distend it with very considerable force without the occurrence of the slightest reflux.

Very shortly after making these experiments I had occasion to remove the cæcum and ascending colon on account of complete obstruction due to malignant disease. In

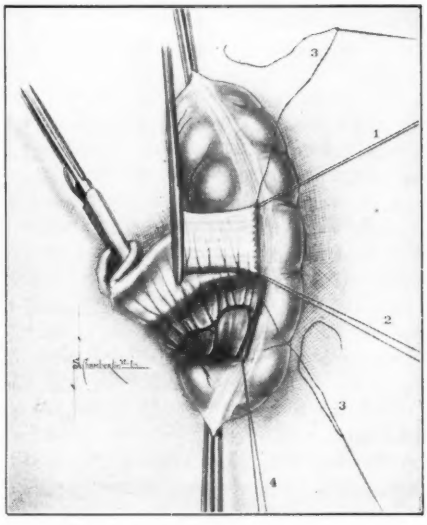

Fig. 24. Third step; first half of outer suture line connecting ileum and pelvic colon in end-to-end anastomosis.

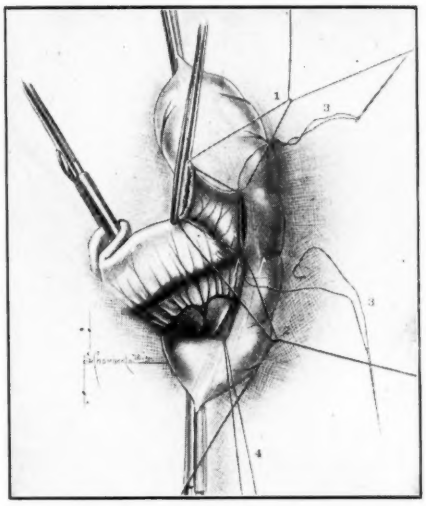

Fig. 25. Fourth step; incision of colon preparatory to application of inner suture line.

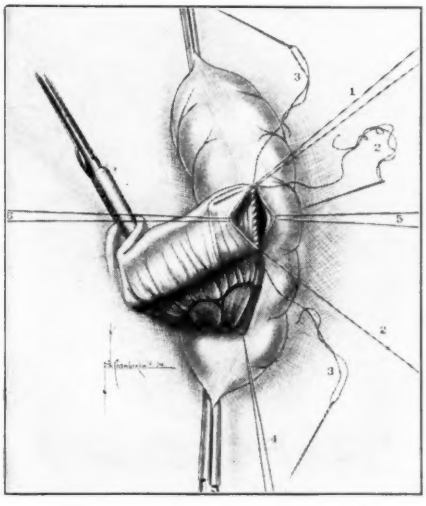

Fig. 26. Fifth step; application of inner suture, first half completed.

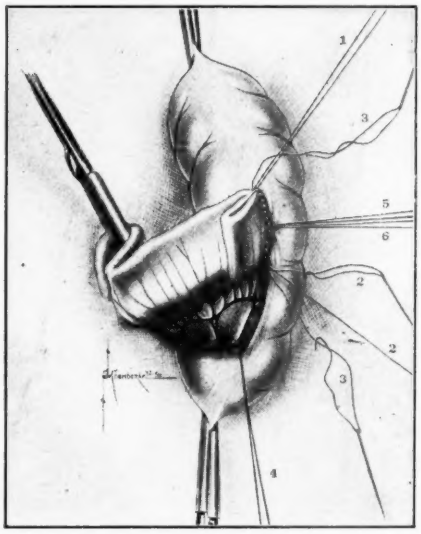

Fig. 27. Sixth step; inner suture line completed.

making the new junction of the ileum with the colon at a second operation I produced an intussusception of the ileum to the extent of about half an inch, and with the result that a perfectly competent valve

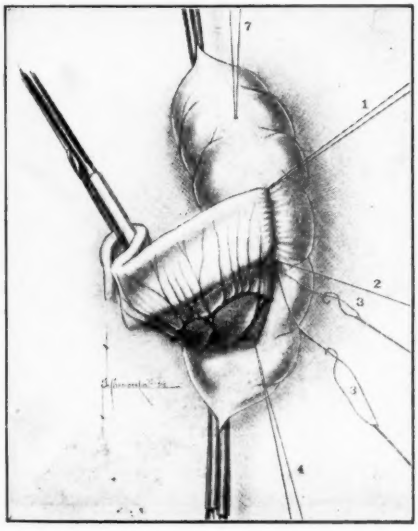

Fig. 29. Outer suture line completed.

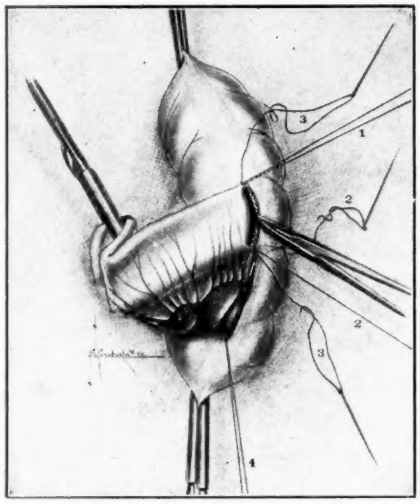

Fig. 28. Seventh; end of ileum invaginated into the colon.

was obtained as shown by subsequent X-ray examination after injection of the colon with bismuth by Dr. Case, röntgenologist of the Battle Creek Sanitarium. Although considerable force was used, it was impossible to cause any portion of the bismuth to pass into the ileum. The valve was perfectly competent and at the same time offered not the slightest resistance to the passage of food into the colon. The patient made an excellent recovery from the operation, but several weeks later died of acute pneumonia with gangrene of the lung. The opportunity afforded for examination of the valve by a post-mortem examination made by Drs. Harris and Case enables me to show the result of this first attempt to produce an artificial ileocolic valve (Fig. 20).

The valve shown is somewhat distorted because the photograph was not taken until after the valve had been hardened with formalin. When first removed from the body the valve had a very regular appearance and very closely resembled the ileocæcal valve of a dog shown in Fig. 21. The technique of the operation will be readily understood from the accompanying cuts.

Fig. 22 shows the ileum cut off at a point about six inches from the colon. With a

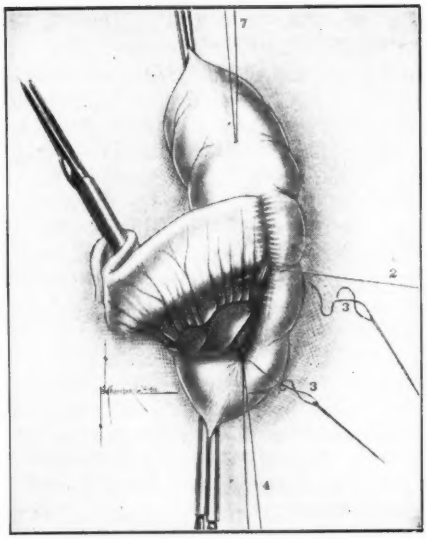

Fig. 30. Operation completed by attaching a portion of the mesentery to colon to prevent contraction at the point of anastomosis.

Paquelin cautery the mesentery is being cut down close to the small intestine so as to leave about three centimeters of the ileum detached from the mesentery as shown in Fig. 23.

The loop of colon, generally the pelvic colon, with which the junction is to be made, having been brought up to a proper position and clamped with rubber covered forceps, the end of the ileum is brought up against the side of the bowel and attached by suture to the bowel close to the border of the anterior longitudinal band as shown in Fig. 24.

A slit is made in the colon at a distance of about a quarter of an inch from the first suture line and the cut end of the intestine is attached to the opening as shown in Figs. 25 to 30.

Fig. 26 shows the inner suture line half completed.

Fig. 27 shows the inner suture line finished, and the fold of intestine which by the next step is to be tucked into the colon through the anastomotic opening, thus producing a valve.

In Fig. 28 the fold of intestine has been inverted into the colon.

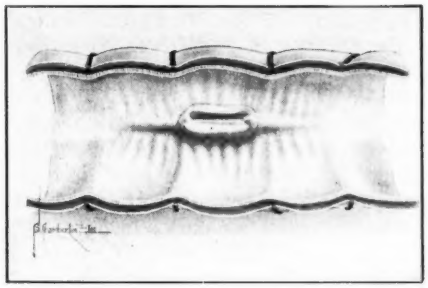

Fig. 31. Appearance of artificial valve from the inside.

In Fig. 29 the outer suture line has been completed. In placing this suture, care must be taken to make sure that the intussuscepted portion of the small intestine is not pulled out, and to avoid distorting the gut.

The edge of the cut mesentery is attached along the edge of the longitudinal band for a short distance as shown in Fig. 30, so as to avoid direct traction upon the line of union. Care is of course taken to attach the cut edge of the mesentery to the mesentery of the colon throughout its entire length, so as to avoid leaving an opening in which loops of small intestine might become tangled, producing obstruction.

Fig. 31 shows the appearance of the ileocolic junction as viewed from the interior of the colon.

Fig. 32. Side view of artificial valve from the inside of the cæcum.

Fig. 32 is a side view of an artificial ileocolic valve made in a case of advanced malignant disease of the stomach involving the transverse colon in which the pylorus was nearly closed and the lumen of the gut occluded. A gastro-enterostomy was done and an ileocolostomy, but the patient's condition before operation had become so desperate that he survived the operation only a few days. The valve was tested before and after death and found to be entirely competent.

As will be seen by the foregoing description, the operation does not differ from the ordinary mode of procedure in end-to-side anastomosis of the small intestine with the colon except in one important particular—that there is a distance of two to three centimeters, measured along the surface of the intestine, between the inner and the outer suture lines. This permits the inverted small intestine to project into the colon about half an inch. The portion of the ileum thus intussuscepted forms a good valve for the reason that the folds of mucous membrane readily fall together whenever there is the slightest backward pressure.

In the opinion of the writer the so-called short-circuiting operation or ileosigmoidostomy, or any other operation whereby an anastomosis is made between the ileum and the colon, should never be performed without the construction of a valve for the prevention of reflux from the colon into the ileum. Without an ileocolic valve to prevent reflux, an ileosigmoidostomy performed for the purpose of getting rid of the intestinal intoxication arising from stasis in a looped, kinked or otherwise crippled colon may leave the patient in a condition as bad or even worse than before the operation by practically converting into a colon many feet of his small intestine.

The best point for attaching the ileum to the colon is near the upper end of the distal leg of the pelvic colon. Great care must be taken to avoid bruising or unnecessary handling of the intestine, so as to prevent adhesions, the formation of which about the point of anastomosis may become a source of obstruction.

THE ABDOMINAL INCISION IN THE TREATMENT OF OVARIAN CYSTS

By P. BROOKE BLAND, M. D., Philadelphia
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SINCE the advent of antisepsis and asepsis in the practice of surgery, the progress made in this department of medicine has been indeed remarkable, a statement which applies particularly to the marvelous accomplishments in the development and perfection of abdominal surgery, where progress has been brought about largely by the gynecologist. The advance in pelvic and abdominal surgical procedures has been progressively along the line of improvement and perfection of technique.

Many of the methods and operative procedures which were employed a few years ago are now regarded as obsolete, and to the keen investigator and operator appear crude, indeed. Many other methods have been modified and improved in accordance with the better understanding of the conditions encountered and the indications for their correction. Numerous new types of operative intervention have been added and one is prone to regard our present day methods as almost perfect. However, in gynecology, as in general surgery, certain operations which were devised and practiced by the pioneers in gynecology have been handed down to us, and, in many instances, not without profit. Frequently other measures cling to us by inheritance and custom and often we are loath to depart from these and adopt the newer procedures, the value of which we fail to early comprehend or appreciate.

For the past ten years I have been most fortunate in being associated with a man who has generously given me every opportunity for study in a rich gynecological service, and naturally, during this time, I have had abundant opportunity to recognize, in a measure, the weak and strong points in the execution of the work and the results obtained thereby.

Lately, I have begun to question whether the present teaching concerning the methods employed in the removal of ovarian cysts is fully justified by the results obtained or by our increased knowledge of their true pathological character. From personal observations and experience with a fairly large number of cases, I am compelled to answer in the negative. To a certain degree, at least, the ultimate results obtained by the removal of ovarian cysts are not so satisfactory as they should be. It is difficult to understand why our increased knowledge of the pathology of these neoplasms has not led us to perform more complete and radical operations than we are doing at the present day. The operative technique of ovariotomy, certain phases of which are regarded as modern, differs little from that employed by the father of the operation, Dr. Ephraim McDowell, over one hundred years ago; nor does the technique differ materially, except in aseptic principles, from that utilized shortly after by his followers in this country, the Atlees and Peaslee. The methods we inherited from these pathfinders are still employed, and the authors of our most recent textbooks on gynecology, with slight modification, advise and use the methods practiced by these men.

The old operation of abdominal incision with the withdrawal of the cyst contents, as instituted by the pioneers, should find but little use to-day, because it is rather unusual, at this period, for one to come in contact with cysts so enormous in size that they cannot be removed through a large abdominal incision, without puncture or without tapping. The latter, in my judgment, is the surgical procedure that should be used almost routinely, excepting, of course, in tumors of inordinate size, which are comparatively uncommon.

An examination of our most modern textbooks on gynecology will show that almost with one accord the advice is given that ovarian cysts should be removed through an incision two or three inches long, thus exposing the tumor, and then to withdraw its contents either through a trocar or by puncturing the cyst wall with a scalpel. This is to be followed by the delivery of the tumor through the small incision as the growth empties itself.

The objections mentioned to the small incision in the present day description of ovariotomy are: that it should not be used in the presence of dermoid cysts, when suppuration is present, when extensive adhesions are encountered, or when the tumor is papillary in character. The greatest objection to the operation and the greatest menace to the patient, malignancy, is not even considered. The authors state that one can readily differentiate the various types of ovarian growths by the color of the sac wall. To a certain degree, this is true; but occasionally the man who relies on this sign alone, and, on its strength, deliberately punctures the sac wall, will have a calamity—a tragedy that could have been prevented by a more radical operation.

I recognize fully the value of determining the character of ovarian tumors by their color, but I am also confident that this sign of differentiation is not infallible. The color of the cysts is frequently changed by chemical alteration of their contents and by hæmorrhage into the cyst cavity. The wall of the dermoid cyst, while not of the bluish pearl character of the glandular growth, is not sufficiently characteristic in color, in my judgment, to warrant a surgeon making a positive diagnosis. One must always keep in mind that unless the dermoid contains bone, teeth, or other resistant substance, its content is always in a fluid state at the temperature of the body.

The statement that proliferating papillary cysts should be punctured does not deserve serious consideration, because it is unusual to find true proliferating papillary cysts of sufficient size to warrant such a procedure. It is universal knowledge that implantation infection, during the course of operation, is not an infrequent cause of the recurrence of

malignant disease after removal of the primary focus; for example, in the abdominal incision. It is also a question whether many cases of recurrent malignant disease in the pelvis are not due to the soiling of the operative field in the course of surgical intervention. It has long been taught that it would not be good surgery to incise a suspicious tumor of the breast and then to continue the operation with the same instrument, because of the implantation of embryonal cells on the newly made surfaces. If it behooves one, therefore, to use every precaution in operating in other parts of the body, for malignancy or tumors suspicious of malignant change, the same care and precaution should be observed in the removal of ovarian cysts, a large percentage of which we have learned are histologically or potentially malignant.

It seems to me that the time has arrived for a radical change in the customary method of treating ovarian tumors by laparotomy. The almost universal advice that these tumors should be, as previously stated, removed through a small incision, after withdrawing their contents either by trocar or tapping, does not harmonize with our knowledge concerning their pathology. We know that 25 per cent of ovarian cysts are histologically malignant and that still an additional percentage, though pronounced by the pathologist benign, are in reality malignant in behavior, as is shown by the development of malignant disease after removal of the growth. We also occasionally see the early appearance of malignancy following rupture of ovarian cysts, even though there has been apparent complete surgical removal of the cyst wall and the escaped contents. Most all men of experience have seen this phenomenon occur. Despite these facts, the old method of puncture-removal is still employed. I cannot refrain from emphasizing the fact, at this time, that the surgeon who confidently relies on the color of the cyst wall to determine its true nature, and from this sign alone deliberately punctures the cyst wall, will have calamitites occur.

I have seen this misfortune occur on more than one occasion. If it is impossible for the pathologist, after a careful microscopic examination, to determine definitely the true nature of an ovarian cyst, it is certainly unlikely that the surgeon can be able to distinguish its character from the gross appearance presented. These tumors, commonly regarded as benign proliferating glandular cysts, frequently contain intracystic papillomata, and to incise or puncture an area of this kind jeopardizes the future of the patient by favoring the recurrence of the disease.

Occasionally one sees an apparently harmless multilocular cyst of the proliferating glandular type contain, in one portion, all the elements of a dermoid. Puncture of a region of this character subjects the patient to very great danger of peritonitis and even death.

Recently a case of this character was operated upon by Dr. E. E. Montgomery in his service at St. Joseph's Hospital. A tumor the size of a large cantaloupe was removed entire. It possessed the general appearance of a simple proliferating glandular cyst, but careful examination of the growth showed a dermoid in its wall, containing hair and sebaceous matter. Had this been a large tumor and the old method of puncture or tapping been employed, a catastrophe, perhaps, would have resulted.

My object in presenting this paper is not to criticize or condemn those methods which have been in use for so many years and which have accomplished so much good, but to present a procedure for the removal of ovarian tumors, as we now see them, which comprises their complete removal through a sufficiently large incision in the abdominal wall to effect their delivery without tapping or puncture. Of course, there are occasionally tumors of such enormous dimension that this method would be inadvisable, but such gigantic growths are now extremely rare.

I have, for the past few years, personally practiced the removal of all cysts through a large incision without reduction, and only in one or two instances have I, on account of their extreme size, been reluctantly forced to abandon this plan and evacuate their contents.

On March 30, 1912, I operated upon a patient in St. Joseph's Hospital, aged 49, who had suffered for several years with a large multilocular ovarian

tumor. She had been advised by her family physician and a consultant not to have the tumor removed as they believed it so large that its removal would probably be followed by a fatal issue. This tumor extended from the floor of the pelvis to the diaphragm, thus completely filling the abdomen. It was successfully removed entire through a large abdominal incision, which extended from the pubis to well above the navel. The incision at the time seemed quite long, but the apparent length of the incision was due largely to the overstretched skin. After the tissue of the abdominal wall recovers its tone, the incision does not appear much larger than the one used in the modern operation for uterine cancer, for fibroid tumors, or for Cæsarean section. The patient referred to above also suffered from gallstones, which were removed at the same time. The growth weighed thirty-nine and one half pounds and measured in length 15¾ inches; in circumference, 33 inches, and at its greatest diameter, 11 inches.

From another patient, some months later, I removed through a long abdominal incision a large parovarian tumor, without evacuation, which weighed 27 pounds, and measured 28½ inches in circumference, 9½ inches in its greatest diameter, and 14¼ inches in length.

VAGINAL OVARIOTOMY

To recommend the vaginal operation in the treatment of ovarian cysts, I regard as dangerous instruction. This procedure should never be used for the removal of ovarian growths except in such rare instances where the tumor can be delivered through the birth canal without tapping, puncture, or danger of rupture. I am aware that certain prominent men especially recommend it in the treatment of ovarian tumors of moderate size. I have seen the operation performed by men eminent in the profession and it was accomplished just as in the old method, by incision of the anterior or posterior vaginal fornix, followed by the evacuation of the cyst contents. It is easy to understand that where infection is present, or where a dermoid is encountered, the danger of peritonitis would be very great, or, in cases of malignant change, it would favor the dissemination of the process. If the growths are adherent the vaginal operation is contra-indicated.

Moreover, in the vaginal operation one is compelled to work, to a certain degree, in the dark, and therefore the advantage claimed of determining the character of the cyst by its color must be sacrificed, and, as has been emphasized before, one is not justified in relying absolutely on this sign.

Careful consideration of this subject justifies the following conclusions:

First. That cystic growths of the ovaries should be removed entire through an abdominal incision sufficiently long to accomplish their delivery.

Second. That puncture and withdrawal of the cyst contents through a small incision is unsurgical and inconsistent with our present understanding of surgical principles.

Third. Tapping and puncture of ovarian growths is not compatible with the modern knowledge of the pathology of these tumors.

Fourth. In view of the above, tapping or puncture of these growths is associated with a danger, not only of infection, but of the dissemination of malignant processes.

Fifth. It is impossible for the operator to positively differentiate the various types of ovarian tumors by their color.

Sixth. The surgeon who relies on the color signs as an infallible diagnostic point will meet with calamities.

Seventh. That the teaching and operative procedures employed in the removal of ovarian cysts has not progressed in accordance with the clearer recognition of the true character of these growths.

Eighth. The small incision, with incision-puncture, should only be employed in very exceptional cases and never where extirpation of the tumor entire can be performed through a large abdominal incision.

Ninth. The old operation should find but little use to-day because the gigantic growths which were encountered by the men who devised the operation of ovariotomy are now rarely seen.

Tenth. The operation should only be performed through the abdominal route. Vaginal ovariotomy should find an extremely limited field of usefulness, and this operation, too, should only be performed in instances where the tumor is freely movable and can be delivered without tapping or without puncture or without the danger of rupture. The latter is favored by the increased manipulation the vaginal route entails.

IRREGULAR KIDNEY VESSELS FOUND IN FIFTY CADAVERS

By RICHARD R. RUPERT, M. D., Chicago
Assistant Professor of Anatomy, College of Medicine, University of Illinois

IN presenting this paper and these specimens to you, I wish to state that the kidneys were removed from the cadavers used in the anatomical department of the College of Medicine of the University of Illinois, of this city, during the present session, 1912–13, and were dissected out by the sophomore students of that institution and removed from the cadavers under my personal supervision.

The cadavers used were received by us from the Demonstrators Association, who in turn received them from the usual sources of supply for such material in Cook County. None of the bodies had been posted; there were 49 males and 1 female, of which 4 were negroes.

Of these 50 cadavers, 35, or 70 per cent, showed a unilateral or a bilateral anomaly of the arteries or the veins, or both.

The literature on this subject is somewhat meager, as the author of each article, with two or three exceptions, reported only one or two or three cases in which unexpected anomalies of the arteries (usually) were found incident to renal operations and reference is usually made to the point of entrance of the blood-vessels into the kidney substance, with little or no reference as to the origin of these blood-vessels (references 1 to 9).

Anatomical textbooks and atlases and surgical textbooks lay but little stress, or none at all, on anomalies of vascularization of the kidney *or any other gland*. Sabotta and McMurrich, Spalteholtz and Toldt, show no plates of anomalies of the renal arteries or veins; Cunningham makes no mention of anomalies. Gray states that "frequently there is a second renal artery which is given off from the aorta, either above or before the renal artery proper, the former being the more common position. Instead of entering the kidney at the hilum the accessory renal artery often pierces the upper or lower pole of the gland." Anomalies of veins are not mentioned.

Piersol and Morris state in substance that the renal artery may be multiple, taking origin from the aorta or any other adjacent artery, "such as the spermatic iliacs (common, internal, or external), median sacral, or inferior mesenteric arteries," or "the renal artery may be absent altogether, its place being taken by a vessel from one or the other of these origins." There is no mention of anomalous veins.

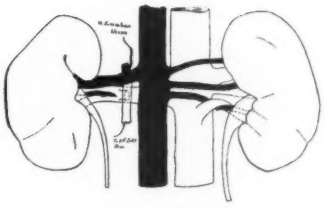
In this series of cadavers from which these specimens were removed *both* kidneys in *every* cadaver were normally placed; i. e., there were no movable, pelvic, or horseshoe kidneys found, nor was there any absence of one kidney, either congenitally or post-operative.

As an operator's caution in anticipation, anomalous renal vessels are in direct ratio to either his past experience, some incidents of which he would not wish to repeat, or to the percentage of anomalous renal vessels reported in the textbook, and as Quaine is the only textbook quoting such a percentage, Quaine's 20 to 25 per cent is usually used as a working basis. But this percentage is based on the *number* of kidneys and the *arteries* only. Gerrish states that "in one case in five an additional renal artery exists, and there may be several."

From a surgical standpoint, where there are two organs of the same kind in the body I believe that statistics would be of more value if based on both the veins and the arteries and the number of cadavers in which such anomalies were found and not upon the number of specimens unless there were a greater number found upon one side than upon the other.

The chances are equal for either kidney to undergo pathological changes as a result of bacterial infection carried to it by the blood or lymph stream, by the continuity or contiguity of tissue. I believe the value of displaying specimens of this kind lies in presenting *both* kidneys from the *same* cadaver, the kidneys still attached to the aorta and vena cava by the renal vessels.

W. A. N. Dorland (10) states: "No abdom-



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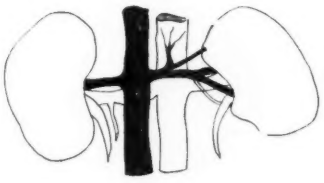

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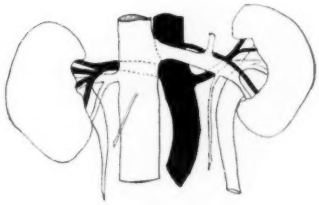

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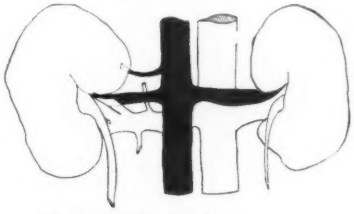

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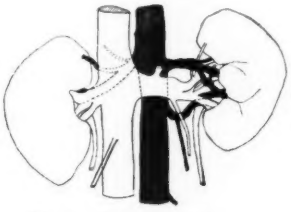

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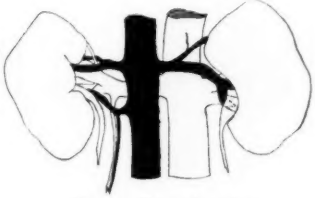

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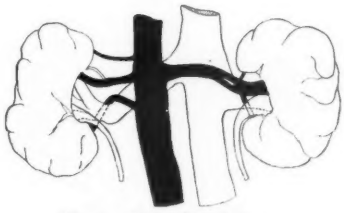

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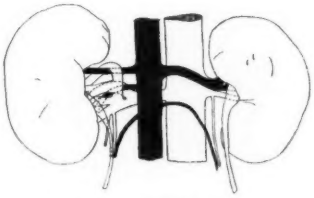

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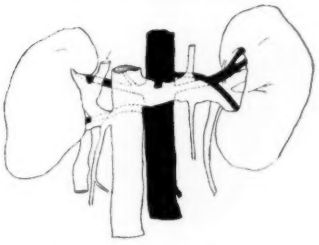

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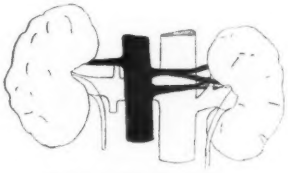

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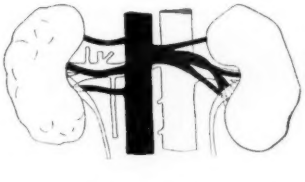

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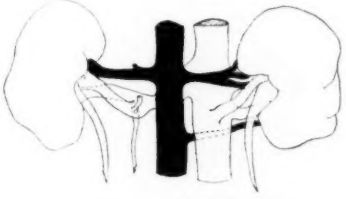

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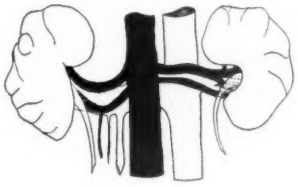

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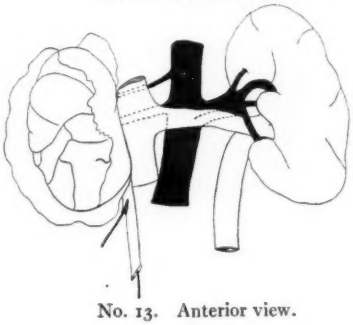

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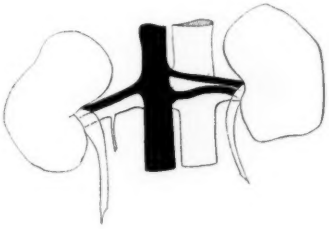

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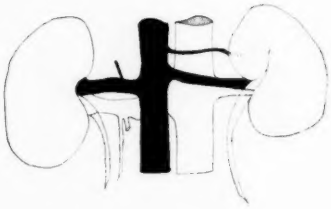

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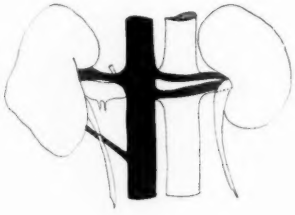

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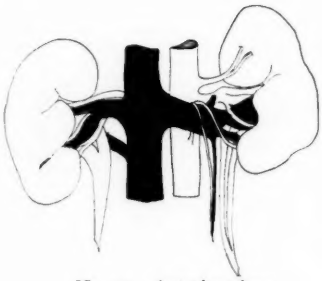

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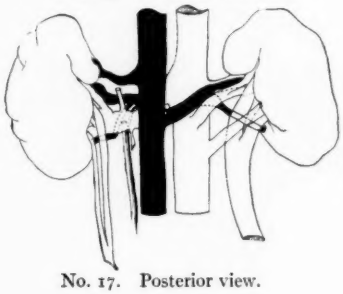

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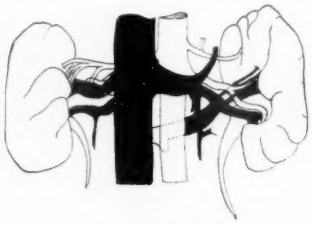

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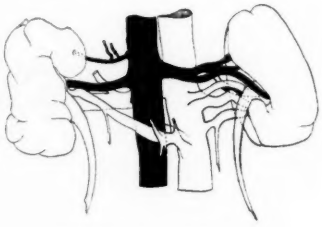

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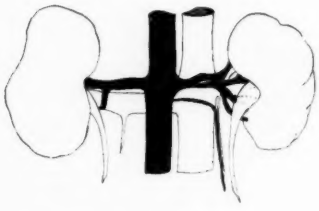

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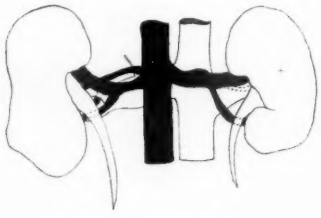

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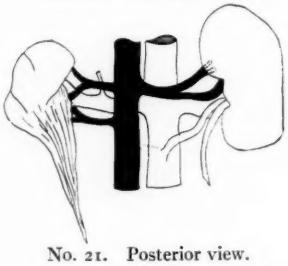

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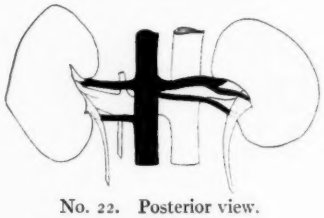

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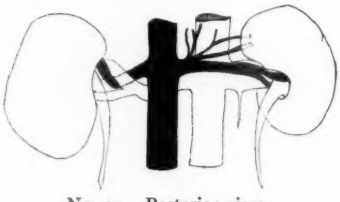

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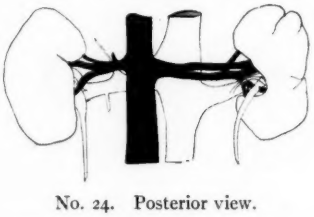

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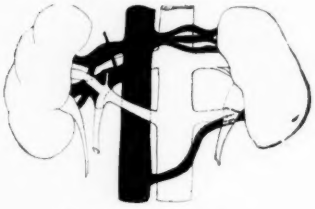
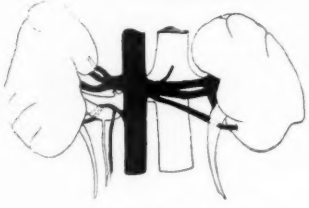
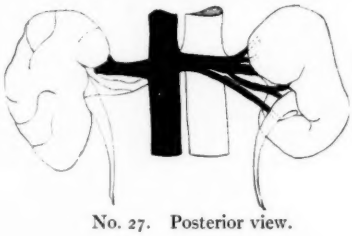


No. 25. Posterior view.



No. 26. Posterior view.



No. 27. Posterior view.

inal arteries are so irregular in their distribution as those which supply the kidneys." While Senator (11) states that "reduplication of one or both renal arteries is a rare condition that may be dismissed at once as it is entirely without significance," yet, considering the arteries only, I found a unilateral or a bilateral anomaly in 34 out of 50 cadavers (or 68 per cent of the cadavers) used by me this year, there being 13 cadavers showing anomalies of the left side, 11 cadavers showing anomalies on the right side, and 10 cadavers showing anomalies on both sides. Of course these statistics are based on cadavers where both kidneys can be examined and not upon surgical cases where only the blood supply of one kidney is seen.

Levings (12) reports "20 or more cases in which there was an anomalous artery going to the lower pole." The Mayos (13) report that in "20 out of 27 cases of hydronephrosis operated by them anomalous blood vessels were present and the obstruction in each instance where the blood vessels crossed the ureteropelvic juncture . . . the vessels passed to the lower pole of the kidney, and varied from the size of a knitting needle to that of a radial."

It has been said that "most commonly anomalous vessels are found at the upper extremity of the kidneys" (14), and that "the veins share the frequency of anomalous distribution" (11). The following table shows the contrast between superior and inferior polar arteries in this series:

Superior pole only, 17 cadavers (34%); 19 kidneys, 12 right, 7 left.
Right 12, Nos. 2, 23, 27, 10, 6, 31, 21, 18, 15, 9, 5, 3.
Left 7, Nos. 24, 8, 23, 27, 20, 9, 4.
Inferior pole only, 9 cadavers (18%); 9 kidneys, 7 right, 2 left.
Right 7, Nos. 19, 26, 22, 32, 20, 11, 17.
Left 2, Nos. 16, 29.
Superior and inferior pole, same side, 8 cadavers (16%); 8 kidneys, 2 right, 6 left.
Right 2, Nos. 1, 25.
Left 6, Nos. 10, 17, 6, 26, 21, 5.
Superior and inferior artery both sides, 0.

The renal veins in this series did *not* "share the frequency of anomalous distribution" with the arteries.

34 cadavers (68%); 44 kidneys showed anomalous arteries; 11 right, 13 left, 10 both sides.
9 cadavers (18%); 11 kidneys showed anomalous veins; 7 right, 0 left, 2 both sides.

SECOND ARTERY TYPE

No.	Artery Left	Artery Right	Vein Left	Vein Right	Axis Left	Axis Right	
3	2						
4	2					2	
5	2					2	
7	2						Right spermatic arteries posterior to vena cava. Spermatic veins empty into renal bilaterally.
9		2					
11		2		3			
14		2					
15		2					
18	2		2	3		2	
20	2					2	
21	2			2		2	
28		2					
29	2			2			
31	2						
32		2					Lowest renal artery curves around the right renal vein.
33	2						
12	2	2					
13	2	2					Right ureter admits broom straw. Left ureter admits ring finger. Vena cava incorporated within adhesions to right kidney.
16	2	2					
22	2	2					
25	2	2	2	2			Superior artery on each side is an axis, each giving off three branches.
26	2	2					Left superior artery axis gives off three branches. Right superior artery axis gives off two branches.
8	2	2					Vein from right renal to trans. fiss. liver.
	17	13	2	5		5	

THIRD ARTERY TYPE

1		3		2			Left renal vein has branches to lumbar veins, also branch penetrating second intervetebral disc.
6	3					2	Lowest artery on left passes up and around left renal vein.
10	3	2					
17	3			2		3	Left spermatic artery passes up and over left renal vein. Left ureter double for three inches. Right ureter double pelvis 1½ inches.
	3	2		2		2	

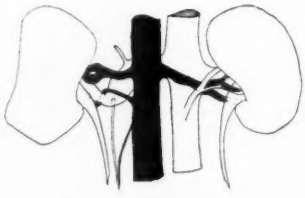
AXIS TYPE

19		2					Right spermatic artery past to vena cava left spermatic artery.
2		2					
23		2					Right renal artery curves around the vein.
24	3	2		2			
27		2					
30	2	2					
34	2						Double pelvis on right kidney.
	3	6		1			

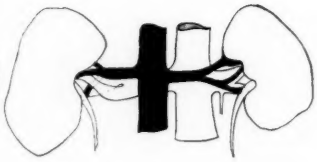
VEINS ONLY

35				2 1			

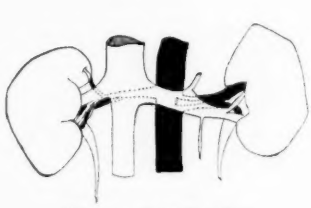
No. 28. Posterior view.



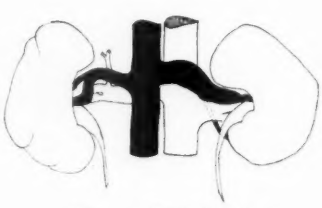
No. 29. Posterior view.



No. 30. Posterior view.



No. 31. Anterior view.



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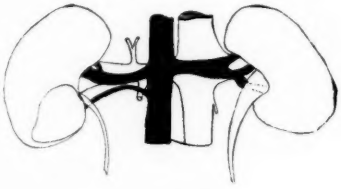

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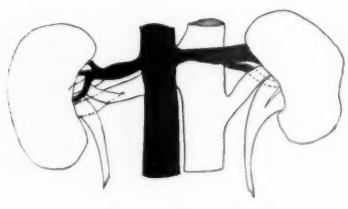
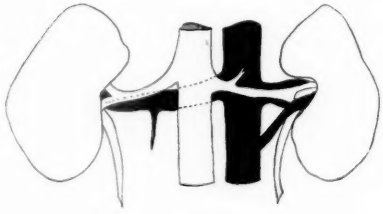


No. 34. Posterior view.



No. 35. Posterior view.

ARTERIES

Left side only	13
Right side only	11
Both sides	10

VEINS

Left side	2
Right side	9
Both sides	2

VEINS AND ARTERIES IN SAME SPECIMEN

Left side	1
Right side	3
Both sides	1

VEINS ONLY

Left side	0
Right side	1–(2)
Both sides	0

One specimen showed an anomaly of the veins only, having two veins on the right side, both leaving the hilum, the inferior vein entering the vena cava opposite the inferior portion of the right kidney. One specimen shows a vein extending from the right renal vein to the transverse fissure of the liver; one specimen shows a vein which extends for about 2½ cm. from the left renal vein where it bifurcates, one branch penetrating the substance of the second or third intervertebral disc, the other branch anastomosing with the lumbar veins on the left side. Two specimens show the spermatic veins emptying into the renal veins on both sides.

Two specimens show that one of the anomalous arteries, in each specimen, makes one complete twist around the renal vein, or *vice versa*; in each instance the artery was as large as a radial. I believe this anomaly is of interest, as the renal plexus of nerves surround the artery, and a very slight twist in an atypical floating kidney could cause all the symptoms of a Dietl's crisis without a movable kidney being demonstrated clinically.

One specimen has a double ureter for about

10 cm. where the two ureters join to form a single ureter; the opposite kidney has a double pelvis about 2½ or 3 cm. long.

Two specimens show the right spermatic arteries passing posterior to the vena cava instead of anterior.

CONCLUSIONS

1. That anomalous renal vessels occur more frequently than is generally supposed.

2. That anomalous veins are as important to consider as anomalous arteries.

3. That while anomalous veins are not as frequent as anomalous arteries, their presence increases the hazards of renal operations, especially in a nephrectomy.

4. That on account of the thinness of their walls they give but little, if any, more resistance to traction than a small adhesion, and as pulsation is absent, an anomalous vein is difficult to differentiate from an adhesion, unless it can be drawn into the field.

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HERNIA OF THE UTERUS AND BOTH ADNEXÆ

With Report of a Case

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THE earliest record in medical literature of hernia of the genital organs is, according to Peyrilke, the author of the Histoire de la Chirurgie, attributed to Soranus of Ephysia, in Asia Minor, who in his treatise on diseases of women, written about 97 A. D., stated that he had seen with his own eyes when practicing surgery, "a loop of small intestine descend in the inguinal canal preceded by one ovary," owing, as he says, "to the relaxation of the broad ligaments which retain and envelop it and together with which the suspensory ligament had also escaped." This case is of interest not only historically as the first case recorded of hernia of the ovary, but etiologically as a description of what we may call the first stage of hernia of the genitalia, as hernia of one adnexa and the uterus is the second stage, and hernia of both adnexæ and the uterus the third or completed hernia of the genital organs.

First stage. Although hernia of the ovary was observed at the close of the first century, it was not until the nineteenth century that such cases were collected and studied. In 1813 Denneux of Paris, nephew of Baudelocque, published his memoir "Sur les hernies de l'ovaire," collecting twelve cases from literature. Loumaigne fifty years later added fifteen new cases. In rapid succession, Hamilton (1870) of Bellevue Hospital reported twelve new cases; Englisch (1871), thirty-eight cases; Puech (1873), sixty-five cases, and Langton, Biemer and Brunner, together with numerous other writers added to the list, until in 1906 Andrews of Chicago collected from literature one hundred and sixty-seven cases of hernia of the ovary alone, forty-six cases of hernia of the Fallopian tube alone, and eighty-two cases of hernia of the ovary and the tube together. In 1912 Heineck of Chicago presented a review [1] of all cases of hernias of the ovary, of the Fallopian tube, and of the ovary and the tube occurring from 1890 to 1910, approximately one hundred and sixty cases in all.

[1] Surg., Gynec., & Obst., 1912, July.

Second stage. Less interest seems to have been aroused in the second stage, or hernia of the uterus and one adnexa. Although cases were reported they are often confused one with another and the accounts are meager and contradictory. Mention is made by the early writers of the nineteenth century, as Boyer in his "Traité des maladies chirurgicales," and Boivin et Duges in their "Traité des maladies de l'uterus" and Davis in "Obstetric Medicine," but no attempt seems to have been made to collect and classify the cases up to 1885. In that year Eisenhart of Munich, when reporting his own case of inguinal hernia of the right horn of a pregnant uterus, collected the histories of twelve cases of hernia of the uterus. In 1888 Samuel S. Adams of this country read a paper entitled, "Hernia of the Uterus," at a meeting of the Washington Obstetrical and Gynecological Society, giving the histories of eleven cases of hernia of the pregnant uterus. Kuestner in 1897 has a list of fifteen cases, to which, in 1905 and 1906, Birnbaum and Hilgenreiner added eight. In this same year, 1906, Andrews of Chicago, who has done the most thorough and complete work on the subject, collected from literature seventy-six cases of hernia of the uterus, but included in the list sixteen cases of ventral hernia and three cases of umbilical hernia. As ventral hernia is not a true hernia through an abdominal opening, but through the separation of the recti muscles, I have excluded these from the list and also the three cases of umbilical hernia which are of doubtful origin. There are then fifty-seven cases of hernia of the uterus of which fifty are inguinal, five femoral, one ischiatic, and one obturator. Of the fifty cases of inguinal hernia, eighteen cases are of hernia of the

uterus and both adnexæ which I will include in the list of the third class, or completed hernia of the genitalia. Widerstein's case is a case of tubal pregnancy in a hernial sac. Boyer's case is undoubtedly that of Pol, described later. Of the five femoral cases, three are hernia of the uterus, and Doringius' case is of doubtful origin and is possibly also Pol's case. The ischiatic is Papen's case, where the uterus did not enter the hernial ring. The obturator is Kiewisch's case, and the uterus had not entered the hernial ring. Of the seventy-six cases of hernia of the uterus, therefore, eighteen belong in the third class, nineteen are excluded as they are not cases of true hernia, and four are excluded altogether as not being cases of hernia of the uterus, leaving thirty-one cases of hernia of the second class. In 1908 Cranwell added eleven new cases. In 1912 Heineck added three more cases, making a total of forty-five cases of hernia of the uterus and one adnexa.

Third stage. So far as I can find in literature, there is only one writer who has collected the known cases of hernia of the uterus and both adnexæ. Bordeaux, in an article entitled "La hernie complete des organes genitaux profond de la femme endehors de la grossesse," in Paris Thèse, 1904–5, has a series of five cases, and reports a case operated upon by Dr. Sorel in Hôpital Pasteur. In the list I offer I will include the cases of hernia of the non-pregnant uterus and of the pregnant uterus which seem to include both adnexæ.

I. INGUINAL HERNIA

(*A*) *Hernia of the pregnant uterus.* (1) The earliest case recorded in literature of hernia of the uterus is that of Nicholas Pol, in 1531. A letter from Michael Döring, physician in Breslau, to William Fabricius of Hildanus, is printed in the latter's "Chirurgical Observations," written in Latin and published in 1612, stating the case as told in Pol's Silesian Journal. This case is referred to in medical literature as Pol's-Döring's, Doringius', Fabricius', or Boyer's, and is confused with Sennert's case described in this same letter. A translation from the original may therefore be of interest. It runs as follows: "A poor woman of Nisse, in Silesia, had in fifteen years borne nine children. It happened in her first labor that owing to her bad temper she was deserted by the midwives and other women and obliged to finish alone, God only the obstetrician (*Solo Deo* obstetricante). At the end of labor she noticed a bad something come out of her abdomen (*Mali aliquid in abdomine sibi evenisse*). In the course of the following fifteen years, she bore eight children without pain worthy of mention, and, Thanks to God, without anything bad happening. When pregnant for the ninth time, she noticed in the left inguinal region, under the skin outside the abdomen, a tumor which moved. Anxious by this, she first consulted her husband and then some women, but received no other help than the counsel to leave the whole matter to omnipotent God. When the tumor increased in size and was distended, it seemed to represent the gravid uterus, and as it increased longitudinally it extended to her knees, and from the movements in the tumor it was now easy for any one to see a living child was contained therein. She now suffered great pain whether reclining or sitting and not without pain could she lift or move the tumor. When it appeared her time was approaching, the Senate of Nisse, knowing she was a poor woman, called a meeting to consider the predicated end, with the physicians, surgeons, midwives, and some honest women, and deliberate since there was no natural way out and no other way to aid the mother or fœtus (as all testified never to have seen or heard of a similar case) than to make an opening in the tumor. When she came into real danger the physicians and surgeons met and imploring Divine aid made an incision over the tumor. After much difficulty and anxiety, they extricated a sufficiently vigorous child, whom with the mother the bystanders congratulated and consoling departed. On the third day following the section, the mother died suffering great and unheard of pain. The child lived for several months."

(2) The next case is that of Sennert, in 1610, related in this same letter of Döring to Fabricius, as follows: "Ursula, wife of Martin Opitz, was hit in the left inguinal region while

helping her husband remove a hoop from a wine cask. A short time later, on the same spot, a rather large tumor formed which was reducible until she became pregnant. It then increased in a short time to such a size it could in no way be brought into the abdomen. Either the patient herself or another person put the idea to her that the tumor was the uterus. A consultation of learned men was called and they agreed there was no doubt but that the uterus was in the tumor and contained a living child. The husband was of good intelligence, and having been made acquainted with the condition and the counsel that a Cæsarean section was the only way, readily agreed, and on April 21st, 1610, in Vienna, Jeremiah Trautmann, together with a sufficient number of able assistants, at eight in the morning opened the tumor and extracted a child. The uterus was not replaced on account of the size. A mild inflammation mostly outside the abdomen persisted fourteen days, then the uterus contracted to normal size, but on May 16th, twenty-five days after the section, the patient died, autopsy showing no light on the cause of death as all the inner parts were in nowise altered."

More than two centuries elapsed before another case was recorded. But in 1716, Louis Leger de Gouey, a physician at Rouen and Paris, in "La veritable chirurgie etablie sur l'experience et les raisons," reported a case of tubal pregnancy in a hernial sac, in the third month of pregnancy. He scarified the tissue with a redhot iron after applying a ligature to the blood vessels and the patient made good recovery.

(3) In 1832 Fischer in the London and Edinburgh Monthly Journal reports a patient of forty-four who had had a right inguinal hernia for ten years previous to her marriage and from which she suffered severe pain in seven confinements. At the sixth month of her eighth pregnancy, the hernia having shown signs of becoming incarcerated, an effort was made to reduce it, with success, when suddenly on lifting she experienced severe pain and now found the pregnant uterus had entered the sac. A Cæsarean section was performed; the mother died thirty hours later, but the child lived.

(4) In 1840 Ledesma, of Salamanca, reported a patient aged 24 who had had a right inguinal hernia before marriage and passed through six labors without experiencing any trouble from the hernia. At the third month of the seventh pregnancy she felt severe pain on the left side and now found that the hernial sac contained a hard body which was sensitive on pressure and irreducible. Later on, fœtal movements were felt in the tumor and at the eighth month Ledesma noted that the head was at the internal arch, the breech and feet at the fundus. This supports Veit's theory that the fœtus finds the position most comfortable for itself. Cæsarean section was performed; the mother died, but the child lived.

(5) Skrivan, of Vienna, in 1849 reported as a case of tubal pregnancy in a hernial sac what seems from the history to have been a hernia of the pregnant uterus and which is so included by Adams and Andrews. Maria Liska, aged 38, had had since childhood a left inguinal irreducible hernia. She was the mother of eight children, the last two being twins, but had experienced no trouble from the hernia during any labor. Early in the ninth pregnancy, she noticed that a hard body had entered the hernial sac and the hernia was not now reducible. Fœtal movements were soon felt and the tumor rapidly increased in size. A Cæsarean section was made when she was seven and a half months pregnant. The uterus was not reducible and was left outside the body. Mother and child both survived.

The following two cases are not included in the list as both adnexæ were not in the hernial sac, but they are given as of interest. In 1877 Olshausen reported a patient with bicornate uterus. The left uterus, which was rudimentary, was together with the tube and ovary in a left irreducible inguinal hernia. The right horn was pregnant in the abdomen. Delivery was normal, and during the involution of the puerperal horn after confinement, the hernia, which had grown smaller, disappeared spontaneously into the abdomen.

In 1844 Winckel and Eisenhart of Munich operated on a right inguinal hernia of tube, ovary, and bicornate uterus; the right horn

pregnant in the third month was contained in the hernial sac, and the left horn was in the abdomen. The history was of a woman of 36 who had borne seven children and acquired a double inguinal hernia immediately after the first labor. When about four weeks pregnant for the eighth time, she noticed a sudden swelling of the tumor. At the third month reduction was attempted, but was not successful and labor was induced. Two days later, as the fœtus was still in the tumor, the sac was opened after Lister's method, and the fœtus removed. A Porro operation was performed, removing the right horn of the uterus, and the patient made a good recovery.

(6) In 1895 Rosanoff reported a patient who acquired a right inguinal hernia between her twelfth and thirteenth labors, which was reducible until she was again pregnant. It was then discovered that the uterus was in the hernial tumor. At the seventh month of her fourteenth pregnancy, labor was induced and the uterus replaced the day after delivery. Eleven weeks later a radical operation for hernia was performed, and the ovary, tube, and intestine were found in the hernial sac, showing the origin of the hernia.

(*B*) *Hernia of the non-pregnant uterus.* (1) As this is the only case which corresponds to the one I wish to present I will give the history in detail. Bylicki, in Krakow, reported in 1878 a patient 39 years old who had had five children. At the end of the second labor, she acquired a right inguinal hernia which was replaceable and for which she wore a badly fitting truss. The sixth confinement, September 19th, 1877, was a transverse presentation. She had a long labor with rough manipulation by a midwife. Eight days later, when feeling relatively well and wringing out some clothes, she felt a great body come down suddenly under the truss. At the same time she was seized with severe pain and lost consciousness. The hernia was now irreducible and painful. On December 16th, 1877, she entered Clinic Madurowicz, at Krakow. On examination of the right inguinal hernia a solid body, 28 cm. long and 20 cm. wide, was found and diagnosed as the uterus, and near it easy to palpate were two ovaries and two Fallopian tubes. February 12th, 1878, Byrk operated. The sac contained the right ligament adherent to the hernial ring, the uterus, two ovaries, two tubes and a hydatid from the left ovary. All the organs were replaced in the abdomen after removing the hydatid. A peri-uterine exudate formed and persisted for some time, but the patient finally recovered, and left the hospital in April, 1878.

(2) The case I present, I give now for comparison with the previous. The patient, Mrs. S., aged 32, had had five children, the oldest 7½ years, the youngest nine weeks. The first four labors were easy midwife cases, the first being of eight hours' duration. When pregnant for the second time, between the second and third months, she noticed a mass the size of an egg in the left inguinal region, which was reducible when lying down and which was tender on pressure. She did not notice this mass later in pregnancy nor during her labor. In the third pregnancy, at about the second month, she again noticed a mass which was now larger but still reducible. It persisted all through pregnancy but disappeared after labor. It did not appear at all during the fourth pregnancy. In the fifth pregnancy it appeared about the third month and was now much larger and more painful but still reducible. She did not notice it during labor nor in the puerperium, but on rising on the seventh day she noticed again a mass on the left side which for four weeks was reducible, but for the following five weeks was irreducible and painful. The patient was examined by Dr. Augusta Vedin, who made the diagnosis of hernia of the uterus and both adnexæ in the inguinal canal, and referred the patient to me in my service at the New York Infirmary. On examination, I found a left inguinal hernia which was irreducible and contained a solid body, broader below than above, firm in consistency and somewhat tender on palpation. Two smaller growths were palpable below this organ and two others on a higher plane in the hernial sac. On bimanual examination, the cervix, which was high in the vagina, was found drawn to the left and continuous with the tumor in the hernial sac. I therefore agreed with Dr. Vedin in the diagnosis of hernia of the uterus and both adnexæ in the inguinal canal. On May 25th, 1908, with the assistance of Dr. Gertrude B. Kelly and the house staff, I opened the hernial sac and found the uterus, two ovaries, two Fallopian tubes and two broad ligaments in a canal of Nuck. The uterus was turned to the right with the left adnexa anterior to the uterus and the right posterior. Both adnexæ and uterus were normal. The hernial ring measured two inches in circumference and the tissues of the canal were very much softened. The round ligament was three or four times its normal size. Owing to the congenital formation of the canal and the size of the ring, together with the nature of the hernia and the fact that the patient was a laboring

CASES OF HERINA OF THE NON-PREGNANT UTERUS

Name	Age. Age Noticed	Side Affected. Type of Hernia	Contents of Sac	Operation	Result
Case 3 Brohl	36 years	Left Inguinal Hermaphrodite Masculine type	Uterus bicornate 2 tubes 2 ovaries	Removal of organs	Recovery
Case 4 Cornil and Brossard	26 years 15 years	Right Inguinal Irreducible Hermaphrodite Masculine type	Uterus 2 tubes 2 testicles 2 epidydimes Epiploön	Removal of organs	Recovery
Case 5 Defontaine	7 months Second month	Left Inguinal Congenital	Uterus 2 ovaries 2 tubes	Organs reduced	Recovery
Case 6 Derveau	69 years	Left Inguinal Reducible Hermaphrodite Masculine type	Uterus 2 tubes 2 testicles Broad ligament	Removal of organs	Recovery
Case 7 Ferguson	32 years 7 years	Left Inguinal Irreducible	Uterus rudimentary 2 ovaries degenerated No cervix	Removal of organs	Recovery
Case 8 Filippini	30 years 18 years	Right Inguinal Irreducible Hermaphrodite Masculine type	Uterus 2 tubes 2 testicles	Removal of organs	Recovery
Case 9 Hudson	9 weeks	Right Inguinal Irreducible	Uterus 2 ovaries 2 tubes Intestine	Organs reduced	Recovery
Case 10 Jopson	27 years Childhood	Right Inguinal Irreducible	Uterus necrotic Right adnexa Right broad ligament Part of left tube	Porro Salpingo-oöphorectomy	Recovery
Case 11 Krymow	46 years	Left Inguinal	Uterus 2 ovaries degenerated Cæcum, ascending colon Epiploön	Radical operation	Recovery
Case 12 Lallement	82 years 42 years	Right Inguinal	Uterus 2 ovaries 2 tubes 2 cysts Part of vagina. Epiploön	Post-mortem	
Case 13 Legueu	18 years Childhood	Left Inguinal Partly reducible	Uterus rudimentary 2 broad ligaments Right adnexa Left tube atrophied	Reduction of organs	Recovery
Case 14 Le Nouene or Bordeau	35 years Childhood	Right Inguinal Irreducible	Uterus 2 tubes suppurating	Uterus reduced Double salpingectomy	Recovery
Case 15 Pfannenstiel	Not given	Not stated Inguinal	Uterus Right adnexa Part of left adnexa Intestine	Reduction of organs after widening the ring	Not stated
Case 16 Rydygier	44 years	Right Inguinal Reducible Hermaphrodite Masculine type	Uterus infantile Right testicle vas deferens Left cyst of ovary	Removal of organs	Recovery
Case 17 Stoneham	9 months	Right Inguinal Hermaphrodite Masculine type	Uterus 2 broad ligaments 2 tubes 2 testicles 2 epidydimes	Reduction of organs	Death 11 days later

woman with a large family, I intentionally cut the round ligament to prevent recurrence of the hernia. Both uterus and adnexæ were easily returned to the abdomen and the wound closed by Bassini's method. The patient made an uninterrupted recovery. She has had one child since with a labor of five and half hours' duration and no return of the hernia. On examination to-day I found the uterus forward in good position and only slightly to the right of the axis of the pelvis.

II. FEMORAL HERNIA

Name	Age. Age noticed	Side Affected. Type of Hernia	Contents of Sac	
Case 1 Cloquet	Not given Hernia for 40 years	Right crural	Uterus 2 ovaries 2 tubes 2 cysts Part of vagina Epiploön	Post-mortem
Case 2 Cruveilhier	Old woman	Left crural	Uterus Right ovary Left tube Other ovary and tube failed	Post-mortem
Case 3 Murat	82 years 42 years after eighth labor	Right crural	Uterus 2 ovaries 2 tubes Part of vagina Epiploön	Post-mortem

III. Umbilical hernia, 0 cases.
IV. Obturator, 0 cases.
V. Ischiatic, 0 cases.
Total number of cases of hernia of the uterus and both adnexæ, 26.

			Operation	Result
I. Inguinal hernia, 23 23 cases	Pregnant 6 cases	Right 4	5 Cæsarean section	Mother, 4 deaths Children, 5 lived
		Left 2	1 abortion induced at the 7th month	Mother and child lived
	Non-pregnant 17 cases	Right 10	*Adnexæ* complete, 5 cases	
		Left 6	*Adnexæ* partial, 6 cases	
		Not stated 1	Hermaphroditic malformations, 6 cases	
II. Femoral hernia, 3 cases	Pregnant 0 cases	Right 2	*Adnexæ* complete, 2 cases	
	Non-pregnant 3 cases	Left 1	*Adnexæ* partial, 1 case	

OCCURRENCE OF THE HERNIA

(A) *Hernia of the pregnant uterus*
4 cases had had hernia before the first confinement.
2 had acquired hernia after labor.

(B) *Hernia of the non-pregnant uterus*
2 had noticed hernia in infancy.
4 had noticed hernia in childhood.
2 had acquired a hernia after labor.
3 not stated.

Hermaphrodites
1 had noticed hernia in infancy.
2 had noticed hernia in youth.
3 had noticed hernia in adult life.

Malformations or alterations of the organs
Uterus: 3 were rudimentary, 1 was necrosed.
Ovaries: 4 showed hydatid cysts, 3 showed degenerations.
Tubes: 3 were atrophied, 2 were suppurating.

Intestine or omentum was present in the hernial sac 7 times in 17 cases.

ETIOLOGY

Several theories have been advanced as to the cause of hernia of the uterus:

1. Kuestner and Eisenhart consider that the intestine or omentum to which an ovary is adherent enters the canal first and draws the ovary after it, the uterus following the ovary.

2. Schulze believes hernia of the ovary to be the first stage and the broad ligament which enters the canal forms a reduplicature and draws the uterus in by a mechanism analogous to the gliding hernia of the large bowel.

3. Eisenhart and Winckel advance the theory that when a short processus vaginalis peritonei exists in the inguinal canal, the round ligament acts on the ovary as Hunter's ligament on the testicle, causing the ovary to make a similar descent into the canal.

4. Englisch, Puech, Eisenhart and Andrews consider that congenital malformations of the genital organs are essential or of vast importance in the formation of hernia of the uterus.

For the formation of a hernia, three conditions are necessary: (1) An opening sufficiently large for the entrance of a viscus. (2) A movable viscus. (3) Some force or attraction sufficient to bring the viscus through the opening.

The first condition, an opening: Inguinal hernia of the intestine is nearly twelve times as frequent as femoral hernia, and is much more common in men than in women, the proportion being ten to one. In women, however, inguinal and femoral hernia of the

intestine occur with equal frequency. Hernias of the ovary or of the tube, or hernia of the uterus, are, however, with few exceptions, of the inguinal variety. The reason for this is chiefly to be found in the inguinal canal itself. The processus vaginalis peritonei, or canal of Nuck, which is analogous to the funicular process in the male, should be closed just before or at birth. If it remains open, a condition exists which is similar to that in the male and which is the cause of the greater frequency of hernia in men than in women and one of the chief causes of hernia of the genitalia in women. If a hernia occurs in the canal of Nuck, it is known as a congenital hernia. The adjective congenital referring to the anatomical condition and not to the hernia, for the latter may not appear until adult life or even late in life, as in Lallement's case. In the acquired type of hernia of the uterus, which is infrequent, if it occurs at all, the history is usually of a previous reducible hernia of the intestine. The uterus takes the place in the sac which the intestine previously occupied, or if the hernial opening is sufficiently large, the adnexæ and uterus enter the sac already occupied by the intestine. Multiple and too frequent pregnancies or twin pregnancies by overdistention of the abdominal wall, and consequent atrophy of fat, may increase the size of the hernial opening, as may also the blood vessels in the hernial canal, especially the veins in the round ligaments which increase in size during pregnancy and contract after labor. If there is a subinvolution of tissue in the ring or if force is directed against the opening before the tissues have had time to involute, as in early rising after confinement, the condition is then favorable for the formation of a hernia.

The second condition, movable viscus:

(1) Cases occurring in infancy: This brings us into the interesting field of intra-uterine pathology. "The causes of abortion and of the death of the fœtus during the different periods of pregnancy are in many instances," Simpson says in his "Contribution to Intra-uterine Pathology," "not to be sought for in any diseased condition of the general system of the mother nor in any morbid state of her reproductive organs, but in diseased actions originating in and more or less strictly confined to the fœtal appendages, or to the organs or tissues of the body of the fœtus itself. Peritonitis in the embryo and fœtus is a pathological cause from which we may yet trace the production of some varieties of malformation in the abdominal viscera as well as the occasional occurrence of various instances of hernias during intra-uterine life." In fœtal life the ovaries and uterus are in respect to position abdominal organs. If an exudative peritonitis occurs in the fœtus at any time while these organs still occupy a position different from that in which they belong in extra-uterine life, they may be prevented from making their descent, or if inflammation occurs before fusion of the Müllerian ducts has taken place, this may be prevented with resulting malformation of organ or malformation by position.

(*a*) Malformation of organ: The Fallopian tubes are formed from the anterior portion of the Müllerian ducts, the uterus and vagina from the posterior portion. At first the two Müllerian ducts lie on the outer side of the Wolffian ducts, which they later cross to meet and enter the genital cord. The fusion of the two Müllerian ducts begins near the lower end of the cord and proceeds both downward and upward, the septum disappearing first in the region of the cervix, then in the region of the vagina, and last in the upper end of the duct at about the fifth month of fœtal life. Any inflammatory process which interferes with this fusion produces a malformation of the genital tract corresponding to the portion of the cord affected and to the period of intra-uterine development. The earlier the inflammation, the greater the resulting malformation. The result may be an imperfect vagina and uterus bipartus when the malformation is greatest, or normal vagina and septum in utero when malformation is least. The atrophy of the ovaries in old age or their removal by operation in adult life produces marked physiological changes in the body. If the ovaries are removed before puberty, non-development of the sexual organs or the secondary sex characteristics result. The destruction of the ovaries in the fœtus leads to even greater failure of develop-

ment in the general body tissues as well as minor sex attributes. The destruction of tissue may be slight in utero but the result will be extensive in the development of the fœtus. It is Harvey's law that malformation consists not in the substitution of an entirely new anomalous type of structure in the malformed part, but simple permanence of some of its transitory fœtal types. "In the lowest type of animal life as the polyp or the planaria, a segment will reproduce a perfect animal. Animals higher in the scale of life as the mollusca or the crustacea have the power of reproducing individual parts, but in man the reproduction of lost parts is limited to regeneration of simple tissues only." There is no actual failure of development, but a part more or less perfectly evolved is then checked in its development or destroyed. It is the persistence then in man of the imperfectly or incompletely developed fœtal type that constitutes a large class of the simple malformation of the genital tract or the hermaphroditic malformation, both of which occur so frequently in hernia of the genital organs.

(*b*) Malformations by displacement: From the same layer of muscle tissue in the plica gubernatrix is formed the round ligament, the muscle tissue of the utero-sacral ligament and of the broad ligament, as well as the outer layer of muscle tissue in the uterus. There is then one continuous muscle sheath spread out over the uterus and ligaments. Any inflammation affecting one would affect the fibers of the whole sheath. If the peritonitic inflammation has been severe in character or extensive about the uterus or ovaries, the contractile power possessed by the fibrous structure in an old inflammatory membrane and the muscle fibers in the broad and round ligaments would draw the adnexæ and uterus to the side of the pelvis and near or into the hernial ring. More especially is this true if the malformation has occurred early before the fusion of the two horns of the uterus has taken place, and there is a consequent lack of countertraction of the other side, producing a malformation by displacement of the organ with the resulting hernia of a one-horned uterus and adnexa or of a double hernia with malformed uterus and adnexa in each hernial sac. A case reported by Billiard of congenital hernia of the ovary with marked shortening of the left broad ligament illustrates this. The ovary is in the left inguinal canal and the uterus is displaced to the left side. The left kidney is dragged down by contraction of cellular tissue and a fold of membrane connected intimately with the abdominal orifice of the hernial sac.

(2) Cases occurring in adults: In cases occurring in adult life, the adnexæ and uterus usually enter the hernial ring either early in pregnancy when the uterus is enlarged and at the brim of the pelvis, or shortly after confinement, when we find a condition similar to that in intra-uterine life. The adnexæ and uterus while undergoing involution and descending from the position they have occupied high in the abdomen to again become pelvic organs, are brought in the neighborhood of the inguinal ring at a time when it is overstretched and its tissues subinvoluted. The lax abdominal walls of women who have borne many children, what the Germans aptly call the hanging abdomen, permits the uterus to be thrown sharply forward, especially in a patient with marked forward inclination of the pelvis, or with a forespringing sacral promontory. The adnexæ then lie in close proximity to the internal openings of the inguinal canals. The subinvolution which keeps the uterus and adnexæ at the brim of the pelvis gives to them an increased mobility owing to the same failure of involution in the broad, round, and ovarian ligaments.

The third condition, force or attraction:

Force as manifested by intra-abdominal pressure is probably the most frequent cause of hernia of the uterus in cases occurring either in infancy or adult life. An ovary or malformed uterus drawn to the side of the pelvis may be readily forced into a processus vaginalis peritonæi by sudden intra-abdominal pressure in infancy or childhood. In cases occurring in adult life after a confinement, the history is usually of laborious work, such as lifting, straining, or washing, undertaken after a short lying-in period, when the uterus and adnexæ are still subinvoluted and high at the brim of the pelvis and an ovary or hy-

datid of Morgagni may be easily pushed through an overstretched hernial ring, particularly if there has been previously a hernia of intestine in the inguinal canal.

Attraction:

(*a*) The round ligament: In adhesive peritonitis in utero the round ligament shortened by contraction and acting from a fixed point in the inguinal canal, aided no doubt by the contraction in the sheath of muscle spread out over the broad ligament and uterus, draws the ovary precisely as the gubernaculum of Hunter draws the testicle into the inguinal canal, the abnormal descent of the ovary being thus analogous to the normal descent of the testicle. Frequently a loop of small intestine, the cæcum or ascending colon, is found within the hernial sac in hernia of the uterus. In fœtal life the testicle and ovary bear a fixed relation in respect to position with the cæcum. If an adhesive inflammation occurs while these organs are in close relation to the cæcum, then the temporary relation may become more or less permanent. The testicle may be retained for a time or for the entire life in the abdomen, or it may as it makes its descent drag a loop of bowel along with it into the hernial ring. If there is a peritoneal attachment of the cæcum on all sides, which is not rare, the loose cellular tissue holding it to the lumbo-iliac fascia offers little resistance and the cæcum may descend with the testicle into the right inguinal canal or into the left inguinal canal, if the peritoneal attachment is sufficiently long, or if the adhesion has occurred early before rotation of the cæcum has taken place from the left side of the body. In a similar way the ovary, which bears the same relation to the cæcum as does the testicle, may be retained at a higher plane than normal, or as it descends to the pelvis may drag along with it the cæcum or loop of intestine met with on the way. A shortened round ligament acting on the ovary would draw it into the inguinal canal and the adherent bowel following after, precisely as in hernia of the intestine in the male.

(*b*) The broad ligament: In many instances, the broad ligament within the hernial sac so envelops the viscus and is so firmly adherent to the peritoneum that it seems to be a reduplicature of it and to form an integral part of the wall of the sac; so much so that it may interfere with reduction of the organs. Scarpa says, in writing of congenital hernia, "The complete artificial reduction of intestine in congenital hernia is chiefly opposed by morbid connections existing between the viscera and the walls of the sac." A peritonitic inflammation involving adjacent structures such as the round ligament and the broad ligament would result in firm adhesions between the opposing surfaces. The round ligament shortened by contraction following peritonitis would drag the adherent tissues up to or within the hernial ring. The ovary lying in the reduplicature thus formed would be swept into the canal as in hernia par glissement of the large bowel. The uterus and second adnexæ then following by traction.

DIAGNOSIS

The diagnosis of the pregnant uterus rests on the signs of pregnancy occurring in a patient together with the changes occurring in a hernial tumor and the absence of all symptoms connected with a hernia of the intestine or omentum of corresponding size.

Hernia of the non-pregnant uterus can be diagnosed only by bimanual examination. In a case complicated by the presence in the hernial sac of intestine, by suppuration, or by strangulation of any of its contents, it would be difficult, probably impossible, to make a positive, correct diagnosis. The size, consistency and shape of the tumor if coupled with a history of its increase in size at the menstrual period and of pain referred at this time to the hernial tumor, should lead one to suspect a hernia of the genitalia. If on bimanual examination the cervix is high in the vagina and the uterus cannot be felt in the pelvis, but is connected with the external tumor, it would establish the diagnosis of hernia of the uterus. If any uncertainty still remained, a sound introduced into the cervix which entered into the hernial tumor would make the diagnosis positive beyond doubt. A smaller body in the same sac would undoubtedly be the ovary on the same

side of the hernia. A second similar body to the median side of the uterus would probably be the adnexa of the other side.

OPERATION

1. The pregnant uterus: If the case is seen early in pregnancy and reduction of the uterus is not possible, one of two operations should be performed. Either an abortion should be induced and a herniotomy performed later — which exposes the patient to the risk of an incomplete abortion owing to the fixed position of the uterus and the difficulty of emptying it, with the far greater risk then of a secondary operation, or the second choice, which is really the operation of election, namely a hysterotomy and return of the uterus to the abdominal cavity, or if dealing with a uterus bipartus, the removal of the malformed uterus after the method of Porro. If the case is seen later in pregnancy, or when the child is viable, a Cæsarean section should be performed with reduction of the uterus if possible. If reduction of the uterus is impossible, or if there is a marked malformation of the uterus, the operation after Porro is advisable.

2. The non-pregnant uterus: Operation on the non-pregnant uterus is imperative, as both uterus and adnexæ are subject to pressure and traumatism and to the periodic congestion of menstruation, with partial temporary strangulation, which leads to atrophic changes. The ovaries have frequently been found undergoing cystic, tubercular, sarcomatous or carcinomatous degeneration. The Fallopian tubes have frequently suppurated, or they may be the seat of a tubal pregnancy. The uterus is in danger of being strangulated and necrosed as in Jopson's case, or it may be impregnated while in the hernial sac. Organs which are neither diseased nor malformed should be returned to the abdomen and the wound closed by the method preferred in herniotomy. If the broad ligament forms a part of the hernial sac and there is great difficulty in separating the ligament from the wall, it may be necessary to amputate the adnexa in order to return the uterus to the abdomen. Hotchkiss' method in dealing with gliding hernias of the sigmoid may be of value in returning the broad ligament to the abdomen.

CONCLUSIONS

1. There are only two varieties of hernia of the uterus and both adnexæ, namely, inguinal hernia and femoral hernia. The inguinal variety is by far the most common and the only one in which hernia of a pregnant uterus has occurred.

2. In inguinal hernia of the uterus, there are two types (*a*) congenital, which is the most frequent; (*b*) acquired, which is infrequent if it occurs at all.

3. Hernia of the uterus occurs in infancy, usually associated with malformation of the genitalia, or in adult life after numerous pregnancies. If it occurs between infancy and adult life, there are usually hermaphroditic malformations.

4. Hernia of the uterus is always secondary to hernia of one adnexæ, but a hydatid of Morgagni or a fold of broad ligament may precede the ovary into the hernial ring.

5. The diagnosis rests on symptoms which are connected with the pelvic organs and not with the intestine.

6. The treatment is always operative, either on the pregnant uterus for the relief of the immediate condition, or on the non-pregnant uterus to prevent degenerative changes in the organs or to avoid the dangers of pregnancy in a hernial sac.

7. The causes are probably not single but several associated.

(*a*) Adhesive peritonitis in intra-uterine life produces malformations and displacements of the genital organs which render them more liable to hernia.

(*b*) The processus vaginalis peritonæi makes an opening favorable for a hernia.

(*c*) In the majority of cases occurring in infancy or childhood it is probably intra-abdominal pressure that is the immediate cause of the hernia.

(*d*) In cases occurring in adults multiple pregnancies, subinvolution of the uterus and adnexæ or a previous inguinal hernia of the intestine are the secondary causes favoring its formation.

(*e*) In some cases it is apparently the round ligament, as Eisenhart and Winckel have stated, that draws the ovary as the gubernaculum of Hunter draws the intestine into the inguinal canal.

(*f*) In certain other cases it seems probable that the broad ligament may first become adherent to the internal ring or to the processus vaginalis peritonæi and form a reduplicature — as Schulze believes occurs in hernia of the adnexæ — and so draw the ovary in by a mechanism analogous to the gliding hernia of the large bowel.

(*g*) If intestine or omentum to which an ovary is adherent is in the hernial sac it seems only logical to consider that the ovary which has made its descent into the inguinal canal, in a manner analogous to the testicle, has in the same manner as the testicle dragged a loop of bowel after it into the hernial sac, the ovary being therefore the origin of the hernia and not the intestine as Kuestner and Eisenhart state.

Hernia of the uterus occurs, then, as Soranus of Ephysia so ably observed in the first century of this era when he said, "I saw with my own eyes a loop of intestine descend in the inguinal canal preceded by one ovary owing to the relaxation of the broad ligaments which retain and envelop it and together with which the suspensory ligament had also escaped."

CASES EXCLUDED

1. Boyer. Undoubtedly Pol's case.
2. Doringius. Doubtful case; has been described as inguinal, femoral or ventral. Possibly Pol's case quoted by Döring.
3. Hilgenreiner. Hernia of the uterus and right adnexa. The left adnexa lay in the hernial ring.
4. Kiwisch. Obturator hernia of the tube and ovary only. The uterus was not in the hernial sac.
5. Lallement's second case. Hernia of the uterus with right adnexa. The left adnexa was only at the internal ring.
6. Leotaud. Umbilical hernia, possibly a ventral hernia.
7. Mueller. Hernia of the uterus and adnexæ in the inguinal canal artificially produced.
8. Murray. Umbilical hernia, possibly ventral hernia.
9. Nores. Hernia of the pregnant uterus in the inguinal canal, but only one tube and ovary noted as being in the sac.
10. Olliver. Umbilical hernia, possibly a ventral hernia.
11. Olshausen. Uterus bipartus; the pregnant horn was in the abdomen, the other horn in the hernial sac.
12. Papen. Ischiatic hernia of the tube and ovary only. The uterus was not in the hernial sac.
12. Rektorzick. Hernia of a one-horned uterus pregnant.
13. Saxtorph. Ventral hernia of the pregnant uterus.
14. Scanzoni. Probably a one-horned uterus pregnant; only one ovary palpated in the sac.
15. Tubby. Hernia of the uterus and ovary; both tubes pulled into the ring during operation.
16. Widerstein. Extra-uterine pregnancy in a hernial sac.
17. Winckel and Eisenhart. Uterus bipartus. The left horn in the abdomen and the right horn pregnant in the inguinal canal.

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A CONSIDERATION OF THE REACTION OF THE HUMAN ORGANISM TO THE CLASS OF FOREIGN PROTEIDS REPRESENTED BY THE SYNCYTIAL CELL

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FOR a better understanding of the reasoning it is necessary to propose certain premises. Whether assented to or not, these form the basis for the work being done.

We have believed for several years that the solution of the reason why every woman who is the host of an impregnated ovum does not develop syncytioma malignum, will be the solution, not only of the toxæmias of pregnancy, but also of the problem of cancer in general.

This last clause is not capable of even suggestive proof. However, we must acknowledge that syncytioma malignum is one of the most virulent cancers known. It is, as it were, cancer at the highest pitch of activity.

It is immaterial whether carcinoma and sarcoma are primarily caused by bacterial life, or are due to the stimulated growth of the cancer cell, it in itself considered as the offending parasite. The final detail of cause is not so important as is the fact that in syncytioma malignum we have a form in which the body can control its inroads, and does in the majority of instances of infection, with the impregnated ovum.

The behavior of the female organism to the implanted growing ovum is that of a body protected from invasion of a foreign proteid, an active living cell. We cannot prove that in the very early stage of implantation and development the body is protected by glandular secretion.

But we can see and perhaps adduce evidence to prove that as the syncytial cells develop there develops coincidently in the mother's blood an antibody which apparently in time limits the stay of the parasite within the womb.

We have used the word parasite advisedly, for while we are attempting to prove that the reaction of the body protection is the same as it would be upon the absorption or injection of any foreign proteid, we must also include the idea that the impregnated ovum and the syncytial cell are alive. They are alive with a different kind of life than is, for example, the typhoid organism, and yet in the same situation as the typhoid bacteria outside of the body politic.

A careful study of the known histology of the implantation and development of ovum and embryo affords these points in regard to the development of syncytial cells.

When the ovum makes its nest, burrowing under the mucosa, the surrounding cells react in such a manner as to throw out a protecting wall of cells, or membrane. In a normal pregnant woman any excursions of syncytial cells into the blood stream is met with death and disintegration of the syncytial cells.

This limitation continues as pregnancy develops and the layer of cells on the villi of chorion next the mother's blood is changed in character to form the syncytial cell of the placenta, different from the layer of Langhans directly underneath, which latter layer disappears as the placenta nears term, and the need for new villi decreases.

The theory of osmosis or of filtration does not appeal to me as being a tenable fact in relation to any cell of any part of either human or animal organism and certainly least of all to the cells of the placenta.

While this discussion does not include the ferments formed by the placenta, it is a necessary corollary to the understanding of the work done that we grasp the idea that every cell of the human body is a vitally active being, having a definite work to do of either manufacturing some product or of excreting some waste; that that cell in its normal habitat has its circle of birth, life, work and death as much as the amœba or any other unicellular animal.

This being so, we conceive that we cannot as yet differentiate as to whether the reaction

manifested is due entirely to the presence of the cell itself or to its product.

Some forms of toxæmia, then, would represent some disturbance of the normal action of the placental cells or some disturbed reaction on the part of the maternal organism to the growing ovum.

That uterine inertia in some of its forms would then be the result of a lack of generation of antibody on the part of the mother and an inability to limit and expel the human parasite at term.

This study is but the natural sequence of thought to ideas expressed in our papers on Typhoid Fever Occurring During Pregnancy, and also on the Toxæmias of Pregnancy and Etiology of Eclampsia.

There seems to be an intimate relation between the behavior of toxæmic pregnant patients and the protective reaction of the mother.

The relief of toxæmia would then rest on the supplying of these antisyncytial bodies to her blood.

PLAN OF EXPERIMENTS

1. It was then sought to prove if possible that the maternal blood contained some body antagonistic to the growth of, or the persistence of, under favorable conditions, the syncytial cell.

2. To develop a more simple test for the presence of pregnancy than the biologic test based on the above experiments.

3. The application of the complement fixation reaction to pregnant blood, using a normal placenta at term in preparing the antigen emulsion.

A systematic study was first made of the unstained fresh placenta, and of the stained hardened placenta, selecting normal placenta as far as was possible.

This was necessary to make comparisons as to any difference either in nucleii or staining reactions in succeeding experiments.

We conceived the idea that if other tissue could be kept alive in serum perhaps the placenta could also, and that a study of the reaction of the cells of the placenta after several days' incubation when exposed to different substances would be of some value.

The attempt was made to preserve for three to four days or longer in an incubator at 37° C. small areas of placental tissue mounted as drop cultures in the serum of the blood obtained from the fœtal cord.

To this serum on one slide was added pregnant blood.

To another slide was added non-pregnant blood, usually my own.

To another, powdered thyroid extract.

It was proposed also to use powdered pituitary gland to another and the powdered mammary gland of pregnancy to another, but at the present writing we have been unable to secure any of these which were free from preservatives.

One culture was made in serum alone, and in one instance small pieces of placenta without serum were incubated the same time to observe the difference.

TECHNIQUE OF CULTURES

The plan suggested by Carrel (4) for cultures *in vitro* was followed as closely as possible.

Small test tubes the size for blood testing were coated with paraffin. When these cooled to 0° C. pipettes used in handling the serum were coated with paraffin and cooled.

The blood from the umbilical cord was selected because it seemed to me that it should be the normal habitat of the syncytial cell, in its active state. This distinction is best understood by again referring to the histology of the placenta and of syncytial cells.

We recall that the fœtal and maternal blood do not commingle, that the villi are covered with two layers of cells, the layer of syncytial cells toward the mother's blood and which are bathed in her blood are described as changing their character, as development proceeds. This change of character may be due to the inhibiting influence of the maternal blood and to the limiting of their virulency and power of procreation, while the deeper layer does not come in contact with the maternal blood and is concerned in reproducing the villi; it is observed also that as the layer of Langhans disappears, the blood supply of the villus is drawn from the fœtal

vessels, and a basement membrane appears on which the syncytial cells rest.

The unbroken line of syncytial cells is unharmed by the maternal serum.

We then propose to incubate the cut edge of the villus in its normal serum and test it with maternal blood.

The blood from the cord is collected in the small tubes, put on ice, taken immediately to the laboratory, centrifuged in a large centrifuge surrounded by ice for five minutes.

The placenta is then taken when delivered, small areas are cut from under the maternal surface, placed in the drop slides with first cord serum alone, next equal parts of cord serum and maternal serum, next equal parts of cord serum and my own serum, again with cord serum in which a small quantity of powdered thyroid gland is placed.

As each slide is made it is sealed with paraffin and put in a caloric bottle previously heated to 37° C. in which is cotton soaked with water.

These are then transferred to an incubator at 37° C.

Of these, so far, five selected cases have been examined, the specimens being examined at the end of three or four days on a heated stage; first, with the low power for retention of cell outline, then for nuclei.

We have not made enough observations to demonstrate whether the cells multiply, but we could demonstrate that the cells retained their outline, nuclei, and appeared as normal as when cut from fresh specimens.

It was found that the carrying out of the technique was most difficult; we could appoint no definite time to be ready to receive specimens and from the many attempts covering a period of two months only five were in any measure successful. Deliveries usually occurred at night time when laboratory help was impossible to secure.

Of the tests made only one proved in any manner positive. In this test the drop cultures of the placental cells retained their form and nuclei in the slide with fœtal cord serum alone and also in the slide with fœtal serum and non-pregnant blood, and in the slide with serum and powdered thyroid gland a slight change or shrinkage in the size of cells was noted.

In the slide made with pregnant blood and fœtal serum, however, the tissue atrophied, there remaining no evidence of either cells or nuclei, showing a marked inhibition and death of cells not present in the other slides under the same conditions.

Of the other attempts one was infected, and the remainder showed practically no difference on the third or fourth day.

It may be suggested that the chance of error in this method is too great to place any confidence on results. In some measure this is true, but it is also true that by careful study and repeated trials we may perfect the technique so that some of the errors are eliminated. As to the question of ferments playing much part in the results, some writers have recently expressed doubts as to the quantity of placental ferments being enough to account for autolysis. (Frank.)

The specimens obtained were on the fourth day hardened in Zenker's fluid, sectioned and stained.

In the one successful culture mentioned above the slides were of great interest. The examination as recorded in the fresh specimen was better shown on staining; the placental cells, mounted in cord serum alone and with pregnant blood also, retain almost the picture of normal placenta.

The slide with thyroid gland extract shows very few placental cells.

The slide with pregnant serum, an entire absence of cells or nuclei.

At this writing we have attempted to draw no conclusions, we are adding this to the work being done to ferret out the antibody present in the placental stage of pregnancy.

TECHNIQUE OF SECOND INVESTIGATION

At the time this was begun we were unable to find in the literature any record of the application of the complement fixation Wassermann technique to the question of antibody in the human blood in pregnancy.

Since that time the paper of H. L. Murray collects the experience of European writers and his own.

This work has not by any means proven conclusive, yet we desire to record our results.

We desire to hold to the presence of an

antibody antigen combination existing until the termination of pregnancy. Our tests, therefore, are made upon women pregnant from five months to term, and in the puerperium. We therefore selected a placenta from a normal patient at term and in preparing antigen No. 1 followed the technique of Wassermann.

The placental tissue ground finely was shaken with ten times its weight of alcohol; was then placed in an incubator at 37° C. for one week, being shaken twice daily. At the end of that time it was filtered, the filtrate evaporated to dryness at room temperature by means of an electric fan, the dry residue dissolved in ether, again filtered, and the filtrate evaporated. Enough ether to take up the residue is again added and then to this acetone is added.

The clear acetone is then decanted, the balance evaporated and the sticky brown residue is weighed and a 3 per cent emulsion made in methyl alcohol.

With this antigen tests were made in the laboratory of the Presbyterian Hospital, using the other factors for the reaction exactly as the routine Wassermann reaction.

Tests were made with:

A normal pregnant blood at term, an eclamptic patient's blood at eight to nine months gestation, both primiparæ.

Blood from a multipara two days advanced in the puerperium. All three gave negative reactions.

In these tests the antigen was diluted five times with normal salt solution and $\frac{1}{10}$ of all of the patients' blood used.

It was then suggested that perhaps the failure to secure a reaction late in pregnancy may be due to insufficient solution of the antigen.

We then next treated a normal full-term placenta in the following manner:

Small portions were snipped off with the scissors, placed in a mortar and thoroughly ground up with equal parts of absolute alcohol and one half normal sulphuric acid solution.

The resulting mixture was incubated at 37° C. for 48 hours, was then filtered, the filtrate evaporated at room temperature, the residue taken up with ether just enough to make an emulsion. This solution was then rendered neutral by the addition of normal sodium hydrate solution. The ether was then evaporated by fan at room temperature. A 3 per cent solution was made with methyl alcohol.

It is to be noted that in all of these tests we have as yet no reliable method of standardizing these antigens.

With antigen No. 2 these tests were made as before by the same technique as the routine Wassermann reactions. One with a patient's blood who is pregnant for the first time five to six months, and who is just recovering from a breast abscess, whose husband had a herpetic eruption on the glans a short time before marriage but who gave at that time a negative Wassermann reaction.

With this blood a positive reaction was obtained.

The second case was that of a primipara seven months pregnant. With this a suggestive, but not definitely positive, reaction was obtained.

The third case was a primipara in the third day of the puerperium, temperature range 102° to 103°, delivered of a macerated fœtus after a long labor with face presentation, temperature somewhat excited by free secretion of milk.

With this blood a suggestive but not definitely positive reaction was obtained.

This same antigen was used in the Jefferson Hospital laboratory with serum from three other patients with a slightly modified technique.

The antigen diluted ten times was used with as much as $\frac{2}{10}$ of a cc. of serum; one from a normal multipara near term; one from a multipara three days advanced in the puerperium; one with my own blood as a non-pregnant serum. With all three of these tests there was no restriction of hæmolysis.

In all of our tests then we secured only one reaction in any manner approaching positive and that from a case in which we might suspect syphilis, although her Wassermann was negative. This but bears out the work reported by other men.

The lack of reaction in the latter half of pregnancy when demonstrated on antigen

prepared from full term normal placentæ admits of several explanations.

To the one already given of inefficient solution of antigen may be added the possible fact that the disappearance of the layer of Langhans and the changed form of the syncytial cells, due no doubt to constant contact with the immunizing agent in the mother's blood, has reduced the antigenetic properties of the placenta to a minimum. It would then seem that antigen prepared from the villi of early pregnancy would be non-active. As a matter of fact, this is so. But it seems to me that such an antigen must be prepared from a normal patient and that should the ovum have been expelled from toxæmia of any type the results in the present state of our knowledge would be clouded. It is manifestly difficult to obtain such a specimen.

In regard to the lack of reaction in the puerperium, one must assume besides the first point of lack of a good solvent that the antibody is a transient autoprotective body which does not confer immunity for a greater time than when the invading syncytial cell is acting.

The results obtained from antigen No. 2 are of some interest. The acid solvent was used to secure any nitrogenous antigen body and in this we find hope of a better result.

CONCLUSIONS

The complement fixation reaction in the placental stage of pregnancy using antigen from placental tissue has not been established.

We believe it is possible to develop such a reaction.

These few reports represent some months of study.

It will take the results of many experiments to establish a method of standardizing such an antigen before we can expect uniform results.

But once having the normal, we hope to find some help in our diagnosis and treatment of the toxæmias of pregnancy.

We must not forget our premise that the pursuit of the study leads us again to the problem of cancer as represented by syncytioma malignum.

The antigen emulsions were prepared in my own private laboratory. The tests were made from cases in my service at the Presbyterian Maternity in the laboratory of that hospital, and co-incidentally through the kindness of Dr. Davis and Dr. Coplin on blood from cases at the Jefferson Maternity in the routine work of that laboratory.

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THROMBOSIS AND EMBOLISM FOLLOWING OPERATION AND CHILDBIRTH[1]

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THE cases of venous thrombosis following operation or delivery may be divided into two groups which are clinically distinct: (1) The cases, usually puerperal, caused by acute infection, in which the pelvic veins are involved; (2) the later developing, and milder, cases of thrombosis, more frequently post-operative, in which the femoral or saphenous vein is most often affected. The infectious origin of the cases in the first group is unquestioned and the interest in them at the present time is focused on the advisability of radical operative treatment. In the second class of cases, the etiology is still in dispute and the prophylactic, rather than the curative, treatment is receiving the greatest attention. It is some of these latter points which I propose to discuss.

The whole subject has been several times reviewed at the meetings of this society, the most recent having been in 1906, when there was a full discussion of contributions by Dr. Johnson and Dr. Boise. In preparing this paper, I have confined my reading to the literature which has appeared since 1906, having studied 145 articles, either in the original or in satisfactory abstract.

My personal experience is limited to five cases following operation and four cases following confinement, supplemented by a number of observations made in the gynecological wards of the Johns Hopkins Hospital.

The first paper in which a large series of cases was analyzed was that of Clark, published in 1902. At the time this appeared, I had completed and had in the printer's hands a short résumé of the forty-eight cases recorded in the gynecological material at the Johns Hopkins Hospital. Thirty-five of Clark's cases were from this same source, a fact which has led to a slight error in some of the later appearing statistics. In a paper published in 1906, I gave the results of a study of these same cases, undertaken to determine the condition of the patients several years after leaving the hospital.

Since Clark's paper there have been published a number of valuable studies based on the material of different clinics, notably those of Friedemann, Wenczel, Burnham, Morley and Bull. The monographs of Zurhelle, of Kelling and the latest, that of Klein, are exhaustive.

Classification. Although the pathologist[2] makes a sharp distinction between thrombosis, phlebitis and phlegmasia, it is impossible to clinically disassociate thrombosis and phlebitis. It should be borne in mind that primary phlegmasia is something different; it is either the descent of a pelvic cellulitis into the thigh, or as Virchow used the term, a thrombosis of the lymph vessels. In true phlegmasia, the swelling begins beneath Poupart's ligament, while in thrombosis it is lower in the leg. It is well also to remember that phlebitis without thrombosis can not cause swelling. Throughout the literature, the terms thrombosis, phlebitis, and thrombophlebitis are used synonymously to designate a certain well recognized clinical entity.

Post-operative or puerperal thrombosis may affect different veins, producing three types:

(*a*) When the involvement is of the pelvic veins alone and there is no gross infection, few symptoms are manifest. In the mild form it is very common and may exist in the normal pelvis or in the diseased pelvis before operation. A somewhat more severe thrombosis of the pelvic veins may be suspected, but rarely proven, in those cases where the convalescence is not quite smooth, being marred by slight fever, accelerated pulse, fleeting pains in the groin, meteorism, etc. It is in these cases of occult pelvic thrombosis that sudden pulmonary embolism occurs, and they are of interest chiefly for this reason.

[2] Buhlig. Am. J. M. Sc., 1908, December.

[1] Read before the American Gynecological Society, Washington D. C., May, 1913.

(*b*) Of the two types which give rise to the classical symptoms, thrombosis of the deep veins of the leg is the more frequent. Embolism may occur, as has frequently been the case from massage; but with care the danger is not great. It is from the developing thrombus that emboli come, rather than from the mature thrombus which has formed sufficiently to occlude the vein and cause symptoms.

(*c*) In thrombosis of the saphenous veins, with redness of the skin and palpable vessels, the pain, swelling and œdema are less severe than when the deep veins are affected. Such thromboses are never the source of emboli.

Frequency. Among 96,000 obstetrical cases, reported by seven writers, there were 381 instances of femoral thrombosis, a proportion of one case in each two hundred and fifty. In this same series of 96,000 cases there were 44 fatal pulmonary emboli, it having occurred once in each twenty-five hundred cases, or in 0.04 per cent. (See Table I.)

Thrombosis is somewhat more frequent after gynecological operations. There were 566 instances after 49,161 operations; i. e., one case in each eighty-seven, or 1.15 per cent. This represents the statistics of twelve different clinics. If the laparotomies, alone, are considered, the percentage is 2.28, there having been 187 instances after 8,167 abdominal operations. (See Table II.)

Following 3,204 myoma operations there was thrombosis in three per cent, a total of ninety-six. Zurhelle reports 3.7 per cent following abdominal operations for myoma, against 2.6 per cent following the vaginal operation. Wertheim had 2.9 per cent after the abdominal and 0.9 per cent after the vaginal operation. Mayo had five fatal emboli after 1712 abdominal hysterectomies and none after 449 cases of vaginal hysterectomy. (See Table III.)

Etiology. Few subjects in pathology have received more attention from contentious authors than has the mode of origin of thrombi. A controversy begun by Virchow and Brücke as to the relative importance of several different factors continues to the present day. It may be said, however, that the trend of present opinion seems to be more and more in favor of the theory that the majority of thrombi originate from the conglutination of blood platelets and red blood corpuscles. This, of course, is not a new idea, for it was first brought forward twenty-five years ago by Eberth and Shimmelbusch and as Adami says, is "an observation, not of one observer, but of a long series of trained pathologists from 1888 onward." The recent articles of Aschoff are of much importance on this point.

Just what the relationship is between the coagulation of shed blood and the formation of thrombi within the vessels, during life, remains in doubt. The processes and the products are essentially different, "yet the similarity in the staining reactions of the hyaline material of the thrombus and the fibrin of the clot seems to indicate that these two substances are chemically closely allied" (Adami). Furthermore, considering the fact that the physiology of blood coagulation is

TABLE I—PUERPERAL CASES OF THROMBOSIS AND EMBOLISM

	Cases	Thrombosis	Per Cent	Embolism	Per Cent
Wenczel, Budapest...	9,257	34	0.36	2	0.02
Rielander, Marburg..	6,000	23	0.4	2	0.3
Richter, Dresden....	16,000	78	0.78	20	0.12
Klein, Vienna.....	34.951	76	0.22	11	0.03
Lang, Bonn.....	7,805	34	0.48	4	0.05
Hoehne, Kiel.....	11,000	55	0.5	5	0.04
Junge, Strassburg...	10,956	81	0.8		
	95.969	381	0.4		

TABLE II—POST-OPERATIVE CASES OF THROMBOSIS

	No. Operations	Thrombosis	Per Cent	No. Abd.	Thrombosis	Per Cent
Burnham, New York.....	9814	94				
Friedemann, Rostock.....	9228	144	1.5	2766	87	3.6
Friedburg, Strassburg....	1349	51	3.5	....	..	..
Goldmann, Heidelberg....	....	..	...	805	15	1.8
Holzback, Tübingen.....	1000	12	1.2	1953	..	...
Klein, Vienna.....	5851	70	1.2	....	39	2.0
Morley, Ann Arbor.....	1756	11	...	....	..	...
Ranzi, Vienna.....	6871	81	1.2	....	..	...
Schenck, Baltimore.....	7130	48	0.7	....	..	...
Schenck, 2nd Series.....	638	5	0.8	....	..	...
Wenczel, Budapest..	....	..	...	523	11	2.1
Wertheim, Vienna.....	5524	50	0.9	1720	29	1.7
Brothers, New York.....	....	..	...	400	6	...
	49161	566	1.15	8167	187	2.28

TABLE III—THROMBOSIS AFTER MYOMA OPERATIONS

	Cases	Thrombosis	Per Cent
Goldmann.....	174	8	4.6
Burnham.....	293	12	4.1
Wenczel.....	105	5	5.0
Duvergey.....	260	4	1.6
Hofmeier.....	389	6	1.5
Klein.....	730	24	3.3
Zurhelle.....	526	18	3.4
Kelly.....	727	19	2.6
	3204	96	3.0

enshrouded in so much uncertainty, it is not strange that there should be considerable doubt as to the conditions and factors underlying the pathological solidification of the blood within the vessels.

The etiology, therefore, of puerperal and post-operative thrombosis is obscure and from the nature of the circumstances it would seem to be a very difficult problem to clarify, for these reasons: firstly, because post-mortem studies are infrequent, being possible only in the comparatively small number of fatal cases of embolism and in the grossly infected cases; and secondly, because the conditions are difficult to imitate in experimental pathology.

The factors concerned in thrombosis have been many times set forth. They deserve, nevertheless, our repeated attention, because practical prophylaxis depends upon our conception of the causation.

The factors, as understood at the present time, are of two kinds: (1) mechanical and (2) biochemical.

Of the mechanical causes the most important are injury to the vessel walls and slowing of the blood stream. Of the biochemical causes there are three—certain poisons which do not concern us here, bacteria, and the products of bacteria.

The main point in dispute as to the etiology of the so-called aseptic thrombosis which follows operation and delivery, is in regard to the participation of bacteria in the causation.[1]

The advocates of the purely mechanical causation argue that infection can not be an essential factor because by far the larger percentage of instances occur in the so-called clean cases, where the wound heals perfectly and there are no evidences of sepsis; because thrombi and emboli very seldom suppurate; because thrombi are usually sterile;[2] because many cases run an afebrile course; because there are usually no symptoms of infection before the thrombosis is manifest; because the number of cases is just as great since the adoption of more perfect surgical technique; because the left leg is more frequently involved; because of the immunity of youth; because of the greater frequency after abdominal than vaginal operations.

Most of these arguments can be successfully answered.

While it is true that the majority of instances follow clean cases, it is equally true that a very large proportion come in cases where there has been some infection, such as the interval appendix operation, or after operations during which some organ has been opened or removed and there is left a pedicle of devitalized tissue. Speaking from the standpoint of bacteriology, sterility is an absolute term; surgically speaking, it is but relative and few would contend that appendectomy or hysterectomy can be made aseptic in the bacteriological sense of the term. There is no such thing as a sterile wound or a sterile pedicle.

The fact that thrombi seldom suppurate argues not against infection, but rather against the introduction of a sufficient number of bacteria to overcome the bacteriocidal effect of the blood. Moreover, it may be the toxin of the bacteria which causes the trouble. This is none the less infection.

Nine tenths of thrombi are sterile so far as aërobic bacteria are concerned. It does not appear that anyone has systematically examined them for anaërobic organisms.

It is stated that many cases run an afebrile course. In practically all of the cases in the series of forty-eight cases before mentioned, there was fever, and in all of my nine personal cases there was a temperature of 101°, or above.

It is also cited as an argument against infection that there is no fever before the onset of the thrombosis. This has been true in but two of my nine cases, and I am not sure that, had a four-hourly temperature record been taken throughout the three weeks which preceded the thrombosis, there might not have been recognized a slight fever. Michaelis

[1] The following authorities believe that infection is a necessary factor in the causation of post-operative thrombosis: Hofmeier, Bland-Sutton, Burnham, Cordier, Wilson, Schauta, Buhlig, Veit, Frankel, Kretz. Kistler, Mendel. Riedel, Watkins.

Others, while not all absolutely denying the rôle of infection, lay the principal stress upon mechanical causes. Among them may be cited: Clark, Klein, Küster, Lang. Busse, Bull, Junge, Zurhelle, Grant, Krönig, Schepelmann, Baldy, Zweifel.

Again there are those who believe either that both infection and mechanical disturbance are necessary, or that sometimes the one factor and sometimes the other factor is the causative agent. In this list are von Franque, Friedemann, Brothers, Rielander, Breuer, Davis, Duvergey, Heller, Kelling, Pfaff, Johnson.

[2] Lubarsch found organisms in only 20 of 215 thrombi examined.

insists that there is always a subfebrile (99° to 100°) temperature at some time before the onset of the complication.

It may be true that the cases are as frequent now as in the earlier days of surgery, but it must be remembered that thrombosis is, for the most part, a complication of severe operations and that it is a late complication. In former days, many of the operations which are now followed by thrombosis were followed by the death of the patient before there was time for the thrombosis to develop.

The fact that the complication is more frequent in the left leg is, I think, a strong argument in favor of the mechanical cause, but it might be explained by the fact that there is more opportunity for infection on the left than on the right side of the pelvis.

Undoubtedly there is immunity in childhood, for in early life infectious processes are common and thrombosis is rare. Some predisposing factor present in later life must be sought in explanation, and the most obvious is the condition of the vessel walls. Small thrombi and more extensive varices are common after middle life and these cause injury to the delicate endothelial lining of the veins. That such thrombi are frequent in the pelvic veins is proven not only by the number encountered during operation, but also by the many phleboliths seen on radiographic examination. Old thrombi are also frequently met with in patients with myoma and carcinoma. Both Wertheim and Duvergey have pointed out their possible significance as regards post-operative thrombosis. Also thrombosis and embolism occur more often in those clinics where a large proportion of the patients have varicose veins. Such is the case at Basel, where von Herff found in three groups of cases, post-operative or puerperal thrombosis in 8.3, 6.6, and 4.9 per cent of the cases.

That the complication is more frequent after abdominal than after vaginal operations bears out Clark's contention that the essential point is the injury done, during the making of the incision, to the vessels of the abdominal wall, more particularly the deep epigastric veins.

There would seem, therefore, to be sufficient evidence of a practical nature to warrant the assumption that injury to the endothelial lining of the veins is a contributory cause.

Virchow emphasized the importance of a slowing of the blood stream. Stagnation alone, however, can not cause thrombosis, for we know that the blood in a segment of vein, carefully ligated in two places, remains fluid. Moreover, thrombosis is rare in heart disease uncomplicated by infection; on the contrary it is common in typhoid fever when the heart is weak and the circulation is poor. It is also more frequent in post-operative patients when the heart is weak from anæmia. One does not, however, see thrombosis in patients who are kept in bed because of anæmia. Bandaging a limb slows the circulation but does not cause thrombosis. Add some factor connected with an operation to the bandaging and thrombosis frequently occurs. Grafenburg, of Kiel, reports some experiments which were made with the view of diminishing the amount of the anæsthetic by bandaging the legs during operation. The experiments were abandoned because there were six instances of thrombosis in a series of seventy-five laparotomies.

The frequency of the complication in the left leg is best explained by the slowing of the stream in the femoral and saphenous veins caused by anatomical pecularities.[1]

We have then sufficient evidence to support the idea that slowing of the stream is an important factor. Many believe that this factor and that of injury to the vessel walls are sufficient causes, but when one considers all of the facts, it would seem that there must be some other cause acting in conjunction with them.

We have seen that the view usually held to-day in regard to the method of thrombus formation is that of a conglutination of the platelets and red corpuscles. Of all the causes of conglutination, hæmolysis is the most important. Adami says: "It is those agents, exogenous and endogenous, which lead to corpuscular disintegration, which characteristically, when exhibited, bring about extensive thrombosis." The most important hæmolytic agents are micro-organisms and many of those which are the least virulent as regards sepsis are the most potent as regards

[1] Kistler. J. Am. M. Ass., 1912, lix, No. 6, August 10.

hæmolysis. Heller of Greifswald, for example, has found that the colon bacillus has a greater power than the streptococcus to produce thrombosis in the presence of a slowing of the blood stream, and believes that B. coli plays an important part in thrombosis in the neighborhood of the intestine. We know that the colon bacillus has a marked hæmolytic action. The same is true of the B. pyocyaneus. Such hæmolytic organisms may be introduced into a wound or may be present in a pedicle and although possibly producing no visible infection, may cause, or contribute to, the causation of thrombosis by their action on the corpuscles. This thrombosis more readily occurs if there has been injury to the vessel walls through rough handling or through old thrombi, or if the blood stream becomes sluggish through any of the many possible causes.

It seems to me, therefore, that puerperal and post-operative thrombosis is due to several causes acting together, and that one of these causes is the hæmolytic action of bacteria. It is not due to infection as we ordinarily understand the term, but is caused by bacteria often so feebly virulent or in such small numbers as to produce no gross infection.

Premonitory symptoms. While there are no absolutely reliable premonitory symptoms of impending thrombosis, the possibility of its development should be kept in mind whenever a patient has a slight temperature for several days and thorough examination reveals no cause for the fever. Michaelis attaches much importance to this subfebrile temperature. Küster, on the other hand, from a study of fifty-four cases at the Breslau clinic, denies that it occurs. It was present in seven of my nine cases.

Mahler has stated that a diagnostic sign of threatened thrombosis is the "treppenpuls," the charted pulse curve rising by definite steplike increases until the maximum is reached. The pulse rate is out of proportion to the temperature. Several observers confirm this premonitory sign, among them Kelling, Rielander in two thirds of his cases, Richter in 63 per cent, Esser in 12 of 35 cases, Katchewsky in 45 per cent. Klein believes that it is of some significance but does not attach great importance to it. On the contrary, Goldmann, Schauta, Schwab, and Zurhelle have failed to find any such characteristic of the pulse. It was present in only one of my five post-operative cases, and was suggestive in two of the four puerperal cases.

Miller has called attention to chest pains of varying severity which sometimes precede by a number of days the onset of femoral thrombosis. They occur in a certain small percentage of cases and when present are most significant, for it is safe to say that a very large proportion of the pleuritic pains coming after confinement or operation are embolic in origin and point to a developing thrombus. Connor's recent papers emphasize this point.

Pain in the groin, mentioned by Rielander, and pain in the leg noted by Kelling, in my cases, have been coincident with the swelling and have been no help as warning symptoms.

Slight enlargement of the threatened leg, discoverable only on taking careful measurements, and increase in the surface temperature as compared with the opposite side, have also been mentioned as premonitory signs.

Prophylaxis. If we accept the theory that thrombosis is due to the hæmolytic action of bacteria acting in conjunction with the two predisposing factors, namely, injury to the vessel walls and slowing of the blood stream, the prophylaxis must be begun before the operation, kept in mind during the operation, and carried out after the operation.

Before the operation or confinement, a careful examination of the veins of the legs, of the groins, and of the abdomen should be made, and if found to be varicose (26.8 per cent of Junge's patients) there is need of particular care. The abdominal incision should be planned to miss the superficial veins, for in so doing the deeper vessels will usually not be encountered.

The points to be kept in mind during the operation, in addition to a technique as near theoretically perfect as possible, are the position of the patient on the table, avoiding a high Trendelenburg posture in fleshy patients and flexure of the knees to maintain the position. Also to be avoided are undue injury by large and deep retractors. All veins should

be ligated before an infected organ is opened or removed, and no vessels should be tied *en masse*. Care should be taken to prevent traction on ligaments containing vessels and to prevent undue cooling of the abdominal cavity. Bandages which are too tight or which cause constriction in the groin are to be avoided.

After the operation, the principal aim in the prophylaxis is to prevent slowing of the blood stream. This is accomplished by a careful supervision of the heart action, by early active and passive exercising of the legs, and by getting the patients out of bed early. During the past five years, there has been much discussion as to the value in this respect of early rising as first advocated by Ries and Boldt. At the University clinic in Vienna, early rising has reduced the thrombosis morbidity from two per cent to one-half of one per cent (Klein), Mayo's [1] percentage was reduced from two to a quarter of one per cent, Kümmel,[2] of Hamburg, has had one fifth as many fatal emboli since adopting early rising. Krönig of Freiburg, is an enthusiastic advocate and reports 2,400 puerperal cases without an instance of thrombosis. At Munich, Aichel states that there was no case among 7,000 obstetrical patients. Other reporters who think that early rising prevents thrombosis are Jayle, Kelling, Goldmann, Zurhelle, Busse, Brothers, Pfaff, Hulles, Vogel, Ranzi, and Küster.

Holzback, writing from Sellheim's clinic, says that getting patients up early has had no influence on thrombosis morbidity, but states that since they have followed it, postoperative pneumonia, which is either embolic or hypostatic, has decreased from 4 or 5 per cent to 0.3 per cent.

Schauta, von Herff, Veit, Bland-Sutton, Mendel, Sippel, Lomer, Roth, Zweifel, and Fromme are not convinced that early rising is any advantage so far as thrombosis is concerned.

In 1909, Klemperer advocated passive motion of the hips and knees of all typhoid patients and stated that he had thereby reduced his cases of thrombosis from ten per cent to practically nothing. Since reading an abstract of his article I have adopted it with post-operative patients with much satisfaction Beginning the second or the third day, the nurse extends the legs and thighs from ten to fifteen times, night and morning, and as convalescence advances, the patient makes the active motions against slight resistance offered by the nurse. This exercise has been found to be pleasing to the patients and has contributed not a little to their strength when they leave the bed, from the seventh to the tenth day. Pool has recently advocated more extensive exercises.

Hoehne, Illman and Duncan, and Chantemesse have attempted to influence the coagulability of the blood, lessening the same by giving citric acid or leech extract, believing that thereby the tendency to thrombosis can be combated. Pfaff also recommends prophylactic medication. This would appear to be illogical, in the light of the researches of Aschoff, Zurhelle, and others, which seem to show that the conglutination of the platelets and the red cells, the essential feature of thrombosis, is a very different process from the formation of fibrin in the coagulation of shed blood.

Treatment. There has been little new in the treatment of thrombosis. Elevation of the affected leg, rest, hot or cold applications comprise the conservative treatment.

Fischer advocates the application of a light bandage, after which the patient is allowed to walk about. He believes that the pressure of the bandage prevents the possibility of emboli breaking off and that it tends to soften the thrombus and aid in its absorption.

Tousey advocates the exposure of the leg to the ultra-violet ray and combines this, in the later stages, with support, massage, and local applications.

Prognosis. There seems to be very little in the literature concerning the ultimate prognosis of crural thrombosis. I have the late histories of 29 of the 48 patients in the Johns Hopkins series. Eight of them had symptoms for about four months and subsequently no trouble. Two had some difficulty in walking for about twelve months and then completely recovered. Nineteen never

[1] Quoted from Pfaff.
[2] Quoted from Bouchacourt.

fully recovered, being troubled with swelling and with more or less pain after being on their feet more than usual. On the basis of these cases, it is fair to assume that about 65 per cent of the patients never fully recover and that if complete restoration is to follow, it will come before the end of the first year, by which time the collateral circulation is as completely established as it ever will be.

The Trendelenburg Operation. In January, 1908, Trendelenburg reported successful experiments on animals which demonstrate the feasibility of opening the pulmonary artery and extracting an embolus. Later in the year he had the opportunity of applying the operation to a man, 45 years of age. One embolus was removed and the patient lived until the next day, when autopsy showed that a second embolus had been overlooked.

Sievers reports having removed two emboli, respectively 15 and 21 cm. in length. The operation was satisfactorily completed and the patient lived for 15 hours. Ranzi of Eiselsberg's clinic, also operated upon a patient, but death occurred in forty minutes. Veit undertook the operation, but found the pulmonary artery clear.

Ritzmann, from experiments on the cadaver, has found the operation anatomically practical, but considers it exceedingly difficult to determine when it is applicable. He studied, at autopsy, 55 cases, and found on the one hand that cases where the diagnosis was clear were so rapidly fatal that there would have been no time for the operation, and on the other hand, when the patients lived for a considerable time after the onset of symptoms, either the diagnosis was not certain or the emboli were multiple and so small that they could not have been removed. The operation applies only to large emboli in the main branches of the pulmonary artery and it is difficult to make such a diagnosis.

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WHAT ARE THE BEST METHODS OF EDUCATING AMERICAN WOMEN CONCERNING CANCER[1]

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I HARDLY think it will be necessary to emphasize before this body the need for public education concerning cancer, nor the probable benefits to be derived thereby. The question is, primarily, what methods can best be employed in a community organized as in America with Anglo-Saxon institutions and, to a considerable extent also, Anglo-Saxon prejudices. It is difficult to estimate the result of educational work except by comparative statistics for a considerable period of time.

Abroad, especially in Prussia, the publication of newspaper articles, sanctioned by government authority, and official communications addressed to midwives and doctors brought about a considerable increase in the number of early cases of uterine cancer recognized and treated. Such methods cannot be employed in our less paternal form of government. For such official instruction we must substitute education "of the people by the people," as Lincoln might have put it. We must have societies organized for this specific educational purpose, supported financially by the laity, who should do all in their power to spread the knowledge of the first symptoms of cancer and the importance of its immediate and correct treatment.

Physicians should be the prime movers in the organization of such societies and must of necessity do practically all the work of instruction, but the control of this educational work had better, as in the case of tuberculosis, be left largely in the hands of the laity. I confess that nine years ago, at the meeting of the International Congress of Arts and Sciences at St. Louis, in the discussion of a paper by Dr. Sampson on the Early Recognition of Uterine Cancer, I advocated that this work be done by the American Medical Association. But the experience of the past few years in cancer educational work at the Barnard Free Skin and Cancer Hospital has convinced me that this is not the best way; that the organization should be in the control of the laity, and only the direction of the work in the hands of the medical profession. Money is a very necessary adjunct to all such educational work, and it is but natural for those who give the money to desire some control as to the manner of its expenditure. The formation of a national association for the prevention and relief of cancer, with branches all over the country, would seem best to accomplish this purpose. The fights against tuberculosis, preventable blindness and the social diseases have all been made along this line with success. The American people are much more willing to accept medical education that is apparently, at least, of their own seeking than such as is rammed down their throats by the doctors.

As to the exact manner in which this educational work is to be done, we may divide the discussion into that of the written word and that of the spoken word. Each have their special scope and advantages.

[1] Read before the American Gynecological Society, Washington, D. C., May 6, 1913.

The written word. It is almost impossible to have printed in a lay periodical intended for general distribution any article upon so distasteful a subject as cancer of the uterus. The only way it can be done is to incorporate it in a general article on cancer and couch the special paragraphs referring to uterine cancer in such words as not to give offense. In spite of the wide circulation thus obtained through some of our women's magazines I do not specially favor this method, as its lack of directness tends to diminish its effectiveness. Women, in matters as delicate as this, are apt to go for advice first to persons of their own sex. The trained nurse, especially the visiting nurse, is often called upon by, or hears of, mothers whose symptoms should be investigated. She should be trained to know the early symptoms of breast and uterine cancer so that they may be taken care of promptly. I would suggest an occasional article in the journals of nursing, besides the distribution of special leaflets giving concise information as to early symptoms. Such leaflets had better be given in person by the doctor, the nurse, or the social worker to the laity. Leaflets that supply the necessary information are more apt to be read if presented personally than they are if sent by mail. Much can also be accomplished, in my opinion, through the agency of women's clubs in the distribution of literature and pamphlets.

The spoken word. There is a directness in knowledge acquired by word of mouth that ordinarily makes it better retained. Hence I believe much can be accomplished by lectures and personal conversation that mere printed matter fails to bring about. The lectures may be given either directly to the laity, before women's clubs or social settlement organizations, or they may be given before groups of such persons as would be most frequently called upon for advice, such as nurses, midwives, teachers, social workers, ministers, or druggists.

More specifically, I would recommend that special stress be laid upon the early symptoms of breast and uterine cancer in the curriculum of all nurses' training-schools and all colleges of midwifery. With the midwives, probably, not a great deal can be done in their present disorganized state. An important factor in the small number of early cases of uterine cancer we get in this country is, doubtless, the lower moral and intellectual condition of the midwife here. Winter in his last statistics reported an efficiency of 100 per cent among the midwives of East Prussia; that is to say, not a single one had failed to recommend immediate examination and treatment in cases suggestive of cancer. I am interested to see what will be the result of personal letters, enclosing leaflets concerning the early symptoms of uterine cancer, which are being sent out to every midwife in St. Louis by the educational committee of our hospital. A more efficient state control of the midwife is essential to any advance along this line.

Our records at the Barnard Free Skin and Cancer Hospital show that a very considerable percentage of cases, in which diagnosis and treatment were delayed, must be laid at the door of the physician. This condition can only be improved by raising the standards of the medical schools and the state requirements for admission to practice. The mere writing of articles on early diagnosis is almost useless, because the doctors whom you most want to reach don't read medical journals.

The most essential feature of this educational work is persistence. Winter could trace in a curve, year by year from 1902 to 1912, the direct influence of interest or lack of interest upon the results obtained. The moment the work slackened a bit the number of early cases diminished again. It is bound to be a long, hard fight before we can hope for results, but I am convinced that results will come.

PYELITIS FOLLICULARIS[1]

By HERMAN L. KRETSCHMER, M. D., Chicago
Urologist to Presbyterian Hospital; Genito-Urinary Surgeon to Alexian Brothers' Hospital

SYNONYMS: PYELITIS GRANULOSA, PYELITIS FOLLICULARIS

THESE two terms have evidently been used for describing the same pathological condition. Paschkis says that we should differentiate between the cases of pyelitis granulosa reported by von Frisch with its concomitant bleeding, and pyelitis follicularis, which is often seen as a co-existing condition in various pathological lesions, as for example, hydronephrosis or nephrolithiasis.

According to this more or less arbitrary classification, the following case should be reported as one of pyelitis follicularis, because of the absence of profuse hæmaturia.

Mrs. S., aged 36, referred by Dr. George Parker, Peoria, Illinois, August 19, 1912. She dates her present illness back ten years. In February, 1902, albumin was found in the urine. This occurred before her first confinement, and she was kept in bed for six or eight weeks prior to delivery. At this time her feet were badly swollen. During her second pregnancy she had no albumin. Following the second confinement she again had swollen feet. After this she was under observation for a long time, but the albumin never disappeared.

Two years ago she went to the hospital and was operated on for a perineal laceration. During her convalescence a high fever developed, which was called malaria, for which she was treated for over two months without being free from fever. At this time, the consulting physicians found pus in her urine, and the pus has been present ever since. The administration of large doses of urotropine seems to control the fever, and the amount of pus becomes less, but the urine is never completely free from pus.

The attacks of fever came on without any regularity, and were accompanied by very severe chills. The temperature after the last attack was 103° F., eight hours after the chill.

For many years she has had a backache. No matter where the pain in the back begins, or where it is most severe, it always winds up on the left side. There have never been any urinary symptoms, nor has she ever noted blood in the urine. Physical examination was negative. X-ray examination was negative. Blood-pressure was 112.

Cystoscopic Examination: The bladder was negative, except for the presence of a slight œdema of the trigone. Double ureteral catheterization. No obstruction to catheters.

URINARY EXAMINATION

Right	Left
Turbid	Clear
Neutral	Acid
Urea, 0.4 per cent	Urea, 0.3 per cent
Albumin,—	Albumin, —
Sugar, 0	Sugar, 0
Pus present	No pus
Casts, 0	Casts, 0
Blood, 0	Blood, 0

PHENOLSULPHONEPHTHALEIN TEST

	Right	Left
Time of appearance	7 minutes	4 minutes
Amount of elimination	2 per cent	15 per cent
Bladder leakage	22 per cent	
Total phthalein output	39 per cent	

On September 12, 1912, the patient was operated on in her home town. Right-sided nephrectomy was done. A very small pus kidney was removed. Recovery was uneventful. Five weeks after the day she was operated on, she had a severe chill and a temperature of 101.5° F. The chill lasted for fifteen minutes, but she was cold for about one and a half hours. The temperature after this attack remained high for three days, whereas prior to her operation the temperature returned to normal after the chill.

A specimen of urine examined by her physician showed the presence of a large amount of pus and bacteria. A second cystoscopic examination, November 7, 1912, showed a slight difference in the appearance of the two ureteral orifices, the right being a little larger than the left. Some œdema of the base of the bladder was present.

DOUBLE URETERAL CATHETERIZATION

Right	Left
No urine	Clear
	Albumin, —
	Casts, 2
	Bacteria, many
	No pus

PHENOLSULPHONEPHTHALEIN TEST

Time of appearance	4 minutes
Total output in 30 minutes	41 per cent

Shadowgraph catheters were passed into both ureters and an X-ray was taken. The right catheter did not move with respiration, and the upper three

[1] Read at the Annual Meeting of the American Urological Association, Boston, April, 1913.

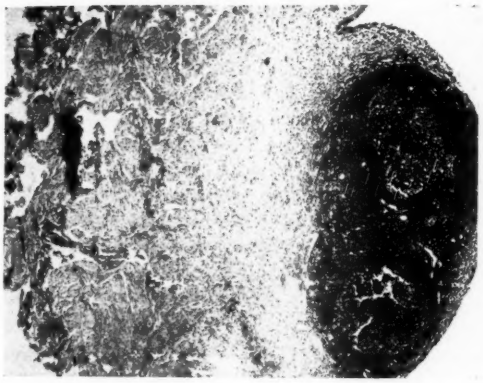

Fig. 1.

inches of the catheter is very plainly visible, so that the eye of the catheter and even the fabric of which the catheter is made are distinctly seen on the X-ray plate. From this it is evident that the catheter lies very close to the X-ray plate and hence must lie in a cavity close to the back.

Examination of the kidney: The specimen is two inches long, and one inch wide and weighs 15 grams. The parenchyma of the kidney has been reduced to a mere shell, being replaced by large sacculations. The pelvis is apparently very much thickened and feels hard. The mucous membrane is thrown up into folds. Situated within the mucous membrane and projecting well above its surface were seen many small nodules, the largest being about the size of a millet seed.

Microscopic Examination: Upon histological examination the nodules were seen to be composed of a light center area, which is surrounded by a darker zone of small lymphocytes very closely crowded together. The center consists of lymphocytes, which do not stain as deeply as do the cells at the periphery. The nodules as well as the surrounding areas are very vascular. The smaller nodules are covered by the mucosa of the ureter. The larger nodules project well above the surface of the mucosa and are only partially covered by it. No ulceration of the follicles was seen. The picture is one of a lymph follicle with a germinal center. Some of the nodules show the presence of two germinal centers. By far the larger numbers of nodules project above the surface of the ureteral mucosa. (Figures 1 and 2).

Up to the present time most of the work on this subject has been done by the pathologists

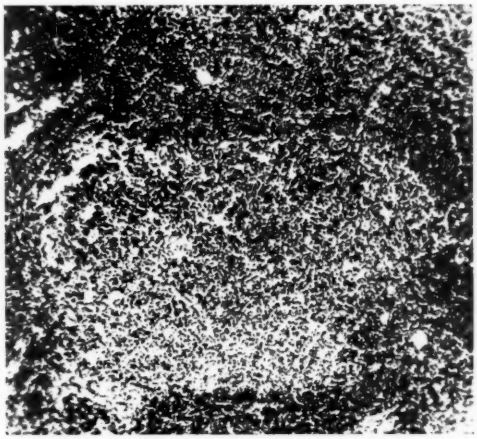

Fig. 2.

and the results of their work will be taken up later in this paper. Recently this subject has received more attention from the clinicians, and for this reason it might be well to consider the reported cases in detail. In the literature at my command I have been able to find records of the following seven cases only:

Solieri and Zanellini (1) report a case occurring in a patient aged 42, who was suffering with attacks of profuse hæmaturia, associated with frequency of micturition and pain at the external urethral orifice. The hæmaturia rapidly became worse, the hæmoglobin going down to 35 per cent. Suprapubic cystotomy showed the blood coming from the left ureteral orifice. Left-sided nephrectomy was done. The pelvis of the kidney was studded with small excrescences like grains of sand. Microscopically they found lymph follicles made of a connective tissue reticulum with a tendency to capsule formation, being identical in structure to Peyers' patches of the intestine. The follicles for the most part were large and round. Blood-vessels were abundant in and around the follicles. In some areas the follicles were ulcerated and opened into the lumen of the pelvis.

The case reported by Taddei (2) occurred in a woman, aged 23. The first attack of hæmaturia was painless, of four weeks' duration, and the hæmaturia ceased with drug treatment. One year later a second attack of

hæmaturia occurred. Cystoscopy showed that the blood came from the right ureter. Nephrectomy. The pelvis showed the presence of miliary nodules. The cells which constitute the follicles have the characteristics of lymph cells. The most superficial lymphatic follicles raise up the epithelium of the pelvis, protected everywhere by its characteristic cellular plan. The lymphatic subepithelial follicles are found to diminish as we recede from the ureteral orifice of the pelvis.

Loewenhardt's (3) case concerned a woman, aged 33, whose only complaint was hæmaturia. The origin of the hæmaturia was proved to be from the right kidney by a cystoscopic examination. Nephrectomy. Six months after the nephrectomy she had another milder attack of hæmaturia. A cystoscopic examination at this time showed a nodular appearance of the mucous membrane in the region of the trigone. The mucous membrane of the pelvis appeared hypertrophic and nodular. Microscopically, there were seen rounded subepithelial masses of round cells, resembling lymph follicles. He also noted an extraordinarily rich vascularization.

Von Frisch (4) had the good fortune to be in a position to report three cases. In all three cases there was a profuse intermittent hæmaturia and a pyelitis granulosa. The kidney pelvis was studded with gray or reddish gray nodules the size of millet seeds which protruded above the surface of the mucous membrane. The mucous membrane of the pelvis showed a diffuse round-cell infiltration. Near the surface of the mucous membrane the mononuclear cells are grouped, forming lymph follicle-like structures, which resemble the solitary follicles in the large intestine. He also found the presence of germinal centers. The blood-vessels were markedly dilated in the neighborhood of the follicles, being well filled with red blood-cells.

Paschkis' (5) article contains an illustration from a case of pyelitis follicularis showing germinal centers, but no clinical history is given.

ASSOCIATED LESIONS

Taddei's case had associated inflammatory changes in the kidney. Loewenhardt's case a subacute pyelopapillitis and an interstitial nephritis. In von Frisch's first case the pathological process was limited to the pelvis and papillæ. In the second case, pyelonephritis; and in the third case, a severe degeneration of the entire kidney.

In the above reported case there were two gross kidney lesions; first, the small size of the kidney, and second, the almost complete destruction of the kidney by a pyelonephritic process.

The kidney was free from associated lesions in von Frisch's first case and in the case reported by Solieri and Zanellini. In two cases, von Frisch's third and my own, B. coli communis were found.

PATHOGENESIS

Various theories have been advanced by different authors as possible explanations for this rather rare condition.

Solieri and Zanellini, who probably were the first clinicians to report a case, advanced a theory which they based on embryology. According to their conclusions, they excluded lymphosarcoma, leukæmia and pseudoleukæmia, because the follicles described have characteristics identical with normal lymphatic follicles with characteristic reticulum and medullary texture. They cannot be compared to ordinary granuloma. "We cannot speak of an infectious process unless we wish to admit the existence of special microorganisms not revealed by ordinary stains, not transportable and non-inoculable, and which are capable of inducing new formations with the attributes of normal lymph follicles.

"Owing to these considerations and because the renal pelvis has diverged from the kidney, derived from the allantois, which is of intestinal origin, we are inclined for want of another opinion to admit an aberration of these same embryonic germs which under the ordinary circumstances give the follicles of Peyer."

Taddei does not agree with Solieri and Zanellini for two reasons. "In the first place, there is no need to say that this quantity of lymphoid tissue in the submucosa of the kidney pelvis is absolutely abnormal. In the second place, all embryologists are not in

accord as to the derivation of the renal pelvis from the allantois."

This brings us to the question as to whether lymphoid tissue is a normal constituent of the renal pelvis. There still remain some differences of opinion among the various writers on this topic.

Chiari (6) published the results of his examinations in which he reports that in the mucous membrane of the urinary apparatus in man, under pathological conditions, there frequently occur collections of lymphatic tissue. He lays stress on the pathological significance of this, because as a result of many repeated examinations in which the mucous membrane was normal, he was never able to find lymphatic tissue present. The pathological conditions which may play a rôle in this formation are inflammatory in nature, especially catarrhal conditions during the presence of which the follicles gradually develop, may persist for a long time and gradually completely disappear by resorption.

Prezowski (7) comes to some rather startling conclusions in his report of three cases coming to autopsy. He has seen a total of fifty-eight cases of this rather rare condition, a number which far surpasses the report of anyone else. It must be borne in mind, however, that his report is based on his findings in the post-mortem room. In regard to his conclusions, he states, first, as these follicles are absent in the mucous membrane of the urinary tract of the new-born, they must therefore be looked on as the result of later development; second, inasmuch as they are often completely absent in adults and in old age, they cannot be considered as normal constituents of the body; third, the nodules vary in one case in size and number and in what appears to be development, so that one cannot help but think that they may develop at any period of life; fourth, the presence in some of the nodules of fatty changes, as well as the presence of ulceration in consequence of suppuration in the nodules, demonstrates that the nodules can disappear at any time. Further, that they are more numerous in a mucous membrane showing inflammatory changes is suggestive that the catarrhal mucous membrane conditions are most favorable for their development. Upon all of this evidence, he thinks that these nodules resembling lymphoid follicles are in the large majority of cases, if not in all, pathological in their origin.

Stoerck (8) says that he examined a large number of bladders in infants from a large series and from various parts of the bladders for the presence of follicles, with the same negative results as were obtained by other authors. There are, however, many other authors who look upon these follicles as constituents of the normal mucous membrane. Thus, for example, Weichselbaum, who examined the bladders of five young men, aged from 20 to 23, who had either committed suicide or were hanged, found lymphoid tissue in all five and came to the following conclusions as a result of his examinations. He believes that one is justified in asserting that under normal conditions lymphoid tissue may occur in the human bladder, though whether or not they must always be present can hardly be determined definitely from the examination of five cases. He believes that whereas these lymphoid follicles may be present normally, but very sparingly, not until they become swollen and enlarged by pathological changes do they become visible microscopically.

In the textbooks on histology also, we frequently find rather unsettled views regarding the histology. Stöhr, Gray and Quain's anatomies do not mention the presence of lymphoid nodules in describing the normal histology of the kidney pelvis and the ureter. Piersol, quoting Toldt, says that occasional aggregations of lymphoid cells occur, which in the vicinity of the calices sometimes form distinct minute nodules within the mucosa. Ferguson, Bailey, Szymanowicz and MacCallum describe the formation of the occasional presence of small collections of lymphocytes, which sometimes form solitary follicles. They do not regard them as of constant occurrence. Regarding the statement of Chiari that these follicles may persist for a long time and gradually completely disappear by resorption, I should like to mention a case previously reported (9), in which I had the opportunity of seeing this phenomenon occur. The follicles were present in the bladder during the time of the patient's illness and were seen with the

cystoscope. Some of the nodules were removed and examined microscopically, so that the nature of the nodules seen with the cystoscope was proved microscopically. About four or five months after the patient left the hospital and when he was free from all symptoms, he was again cystoscoped and at this time the nodules had disappeared. It is difficult to state whether a similar occurrence might take place in the pelvis of kidney.

In regard to the diagnosis this probably can never be made except at the time of operation. In those cases presenting the clinical symptoms of profuse hæmorrhages, it might be well in going over the possibilities to consider the presence of pyelitis, granularis or follicularis. Further than that I do not think we can venture.

The treatment will depend on the conditions found at the time of operation. If the kidney is perfectly normal, as occurred in one of von Frisch's cases and in the case of Solieri and Zanellini, measures other than nephrectomy should be instituted, unless, of course, there be danger due to loss of blood on the part of the patient. It might be well to consider the use of pelvic lavage; in those cases in which bacillus coli communis infection is present, to employ vaccines. There are only two cases on record in which the colon bacillus was found, one of von Frisch's cases and in the case just reported.

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THE POSSIBILITIES OF PRESERVING THE INTEGRITY OF POTENTIAL BODY CAVITIES BY THE USE OF A FOREIGN BODY TO PREVENT ADHESIONS[1]

By FREDERICK PRIME, Jr., M. D., New York City
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THE possibility of trying to preserve the integrity of the potential body cavities has been a fertile field for investigation ever since our modern laboratories have made possible observations along such lines.

So many evil consequences are the direct result of such cavities as the abdominal, the cerebral, and the joints being partially or completely obliterated, that anything which will alleviate such a condition will be of the greatest benefit to many unfortunate sufferers.

Much has been done in the study of this sequel to many of our commonest operations, and various methods have been introduced in an endeavor to avoid any trauma at the time of operation which might result in adhesions.

In the majority of cases these cavities are obstructed by new connective tissue, forming adhesions, which is the direct result of some inflammatory condition, or a trauma such as may follow an injury or an operation in this region, and many efforts have been made to find some substance which, when introduced, will prevent the apposition of surfaces by clots and hinder connective tissue growth between them.

Adhesions, as we know them, are formed by the growth of new connective tissue, which has been stimulated into increased activity by some irritation, often such as must necessarily take place at the time of operation, no matter how skillfully it may be done, for it is well known that the less handling and injury done at operation, the greater are the chances that no adhesions will be formed. Any injury done to the delicate tissues at the time of operation must result in some reaction, and an exudate be thrown out, or it may be that there is a slight hæmorrhage, so small as to pass unnoticed or demand no attention. The wound being closed, the sides of the cavity may thus easily be fixed one to the other by the exudate or the blood, which forms a framework through which connective tissue grows rapidly, and more or less obliterates the cavity.

By various experiments it has been found that connective tissue does not grow unless it has some network or support along which to climb, and that it is unable to grow into dead spaces or elsewhere, without some means of support.

The solution, naturally, to such a problem, after due care has been taken to minimize as far as possible the injury done at the time of operation, is the finding of some material which will prevent the obliteration of the cavity by the growth of connective tissue, when introduced against opposing surfaces, or in such places where blood clot or fibrin can act as a network along which these cells may grow.

The present investigation was undertaken in order to continue a series of experiments conducted some years ago in regard to adhesions, especially as found within the cranial cavity, in which it was shown that the best results were obtained where no foreign substance was used and a stream of warm saline solution allowed to flow gently over the operative area.

This, however, was far from giving an ideal result, and it was felt that in order to obtain a more favorable one, it was necessary to find, if possible, some substance which, when introduced and allowed to remain indefinitely, would be a truly non-irritating body. The foreign materials which have previously been used have all been irritants to a greater or less degree, and usually caused a worse condition than the one they were supposed to cure, stimulating rather than retarding the growth of connective tissue. Especially has this been the case where such substances as

[1] Read before the New York Academy of Medicine, February 6, 1913.

rubber tissue, gold and silver foil, or animal tissue as egg or cargile membrane, were used. Absorbable materials seem less desirable practically, though theoretically they should be more so, than non-absorbable ones, for upon disintegration, the remaining particles act as a supporting framework for the production of new connective tissue growth.

The ideal material should therefore be a non-absorbable, non-irritating foreign body, and it has been with this in mind that the following experiments have been undertaken. The finding of such a material, which would answer the purpose and at the same time be easily handled and readily sterilized, and yet of a sufficient degree of thinness, was a difficult one. From previous experiments, and in going over the ground already covered, celluloid seemed in many ways to be the ideal type of substance, the drawbacks to its use being the inability to procure it in sufficiently thin sheets, and because the chemicals employed in its manufacture are in themselves irritating. This naturally suggested celloidin, which had been used by Maximow about 1901, and even earlier by Alferow and Sirzow, in experiments on growing connective tissue, and they found it pliable against the tissues and easily made into any desirable form. Though celloidin has been recognized and used for so many years, in a careful review of the literature no record has been found of its having been used in an effort to prevent the formation of adhesions.

To use celloidin it was necessary to obtain it in such a form as to be available for this work, and as nothing of the kind was found on the market it took some time to acquire a method which would produce the necessary sheets.

In making the sheets and tubes used throughout these experiments, a thin, etherous solution of German celloidin (Schering) was employed, and after many failures it was found that glass moulds covered with a thin layer of beeswax, and then evenly coated with one or more layers of celloidin according to the thickness required, was the best method of obtaining them.

The forms being coated, it is essential that the celloidin should be allowed to become absolutely dry, and this process must be a slow one, at about average room temperature, and several weeks may be required before they are ready to be removed and used. As to their removal, in the case of the tubes it is only necessary to immerse the mould for a second in boiling water, when the wax will quickly melt, allowing the celloidin to be slipped off, after which they should be placed in chloroform for some hours in order to remove any wax which may have remained adherent. The same method has been used in removing the sheets, but it has been found more satisfactory, when they have been thoroughly dried, to peel them carefully off the mould and then remove the excess of wax with chloroform, after which they are ready for sterilizing before using. By this method there is practically no limit to the size of the sheets and tubes which can be made, and the former can be made of tissue-paper-like thinness, though at the same time they are extremely tough and pliable (Fig. 1).

As thus prepared, the tissue can be readily sterilized, either by boiling in plain water, or by wrapping the sheets in paper and sterilizing in the autoclave under pressure. When this latter method is used, the greatest care must be exercised to keep the celloidin away from any metal or it will burn, and crumble upon being opened.

One decided advantage in using celloidin sheets is that there is no difficulty experienced in manipulating them when the hands are moist, as is the case with cargile membrane, and they can be moved if once placed on a moist surface, where other materials will only stick and tear, and can be wrapped with ease around nerves and tendons, or placed within the abdominal or other body cavities, if necessary, without any difficulty, but they cannot be stitched.

In order to ascertain whether celloidin could be used to advantage in situations where adhesions are most apt to form, the brain, joints and nerves were selected as the most suitable places to introduce the tissue, with the results which I shall presently bring before your notice.

In a number of cases small celloidin tubes were implanted in the cortex to see whether

Fig. 1.

Fig. 3.

connective tissue would grow into them or be attached to the side, in other cases the sheets were used in places where it was known that without them adhesions would be found soon after operation. In the experiments rabbits and dogs were used and as irritation was more profusely responded to in the brain than elsewhere, more experiments were undertaken within the cranial cavity than in other situations.

The technique was as follows: In the cranial cases, the majority had an osteoplastic flap reflected, though in a few the bone was removed and any profuse hæmorrhage from the skull checked by a small quantity of Moorhof-Mosetig wax. The dura was then opened, and in some cases the surface of the cortex sponged with gauze to favor the formation of adhesions. Following this, a small piece of celloidin sheet was introduced between the dura and the brain, and the former, in the majority of cases, was closed with fine silk sutures.

When tubes were implanted, on exposing the cortex, the least vascular area was selected, a blunt probe introduced into the brain substance, and along this tract the tube inserted. The brains exposed in some of the rabbits were so small that it was often diffi-

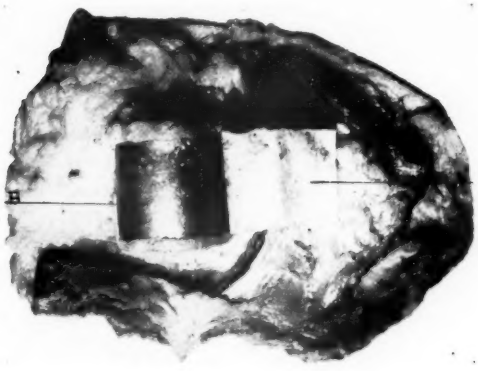

Fig. 2.

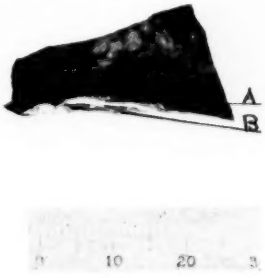

Fig. 4.

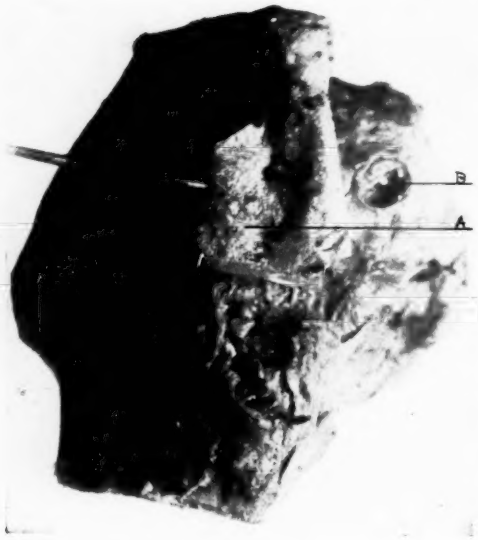

Fig. 5.

cult to select what was supposed to be a silent area, so that in one or two cases signs of hemiplegia ensued, which did not, however, interfere in the least with the experiment.

Where the operation was upon a tendon or nerve, they were cut and sutured, and then surrounded by a tube or tissue.

A foreign body, placed anywhere within the tissues of the body, when it is non-absorbable, we expect to find quickly covered with

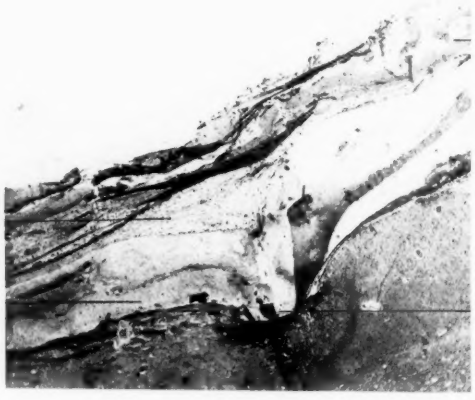

Fig. 6.

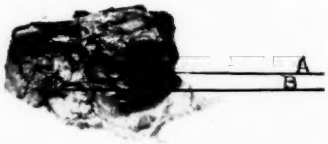

Fig. 7.

a dense mass of adhesions. With celloidin, however, the picture is somewhat different, as may be seen in Fig. 2, lent me by Dr. William C. Clarke, where a large celloidin capsule was placed deeply under the skin of a dog and allowed to stay for two months. At the end of that time it was found covered with a dense sheath of connective tissue, which was smooth and glistening, but without the slightest trace of adhesions of any sort to the capsule. The microscopic section of this connective tissue showed that it was dense and made up of structural cells and fibers, and was denser against the capsule (Fig. 3). This same condition was found in practically all the cases where celloidin was used. Within the cranial cavity there would be no adhesions if a piece of celloidin were placed beneath the dura, but between the celloidin and the dura, and often between the celloidin and the brain, a connective tissue membrane would form which was smooth and glistening and free from fibers binding it to the underlying tissue. The same thing was found along the nerves, and even when, as a mass, the celloidin was found wrapped in the omentum, the same glistening membrane was found, with the celloidin quite free within it.

The explanation of these phenomena seems to be that at the time of operation, when, for example, the dura is opened and manipulated, there is sufficient injury done to this delicate membrane to set up a reaction, and cause an exudate to be thrown out. The celloidin present prevents this from reaching the underlying surface, so that when the connective tissue begins to grow into this exudate, it simply grows along the surface of the celloidin

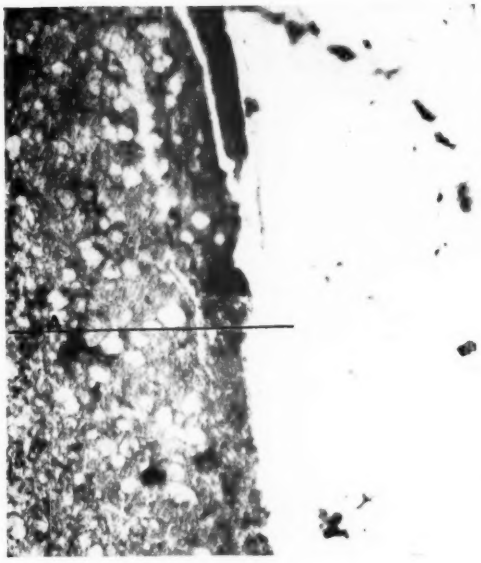

Fig. 8.

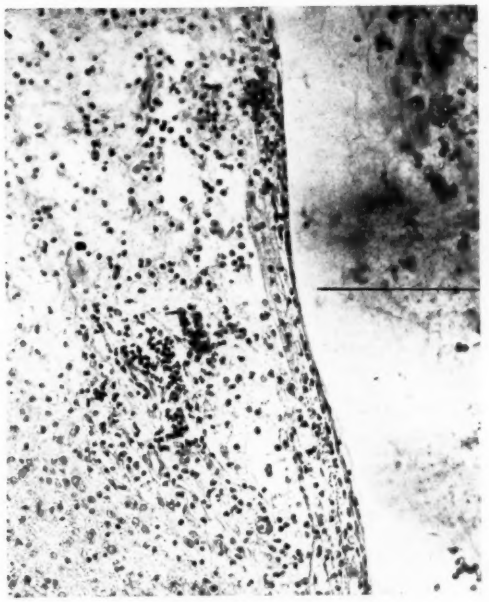

Fig. 9.

and the dura, thickening the latter. The same thing may occur along the under surface of the sheet, if any trauma has been done to the cortical surface, but at the same time the celloidin has prevented any adhesions forming between the dura and the brain (Fig. 4).

In the first series of the following experiments, rabbits were used, and celloidin sheets placed under the dura, and the animals allowed to go from two to six weeks before being killed. At the end of two weeks, autopsy showed no adhesions between the celloidin and the dura, and though there was a slight infection and exudate under the celloidin, the latter was free and not bound down (Fig. 5).

Where four weeks had elapsed between operation and autopsy, there were dense adhesions found between the dura and the overlying muscles, the bone having been removed at operation, but between the celloidin and the dura there were none, though the latter was somewhat thickened, nor were there any between the celloidin and the cortex, which was perfectly normal in appearance.

At five weeks there was no gross examination made, but the specimen was decalcified and embedded, and cut in serial sections, and

Fig. 10.

Fig. 11.

there were no adhesions present, as may be seen by the photomicrograph (Fig. 6).

The results at the end of six weeks were the same, and the gross specimen showed a cortex which was free from any adhesions to the overlying sheet (Fig. 7).

In three rabbits celloidin tubes were implanted in the cortex, and in the first one, examined at the end of five weeks, the microscopic sections showed no adhesions to the tube, and though in some cases there were evidences of hæmorrhage from the injury done by inserting the tube, it did not show evidence that the tube had acted in any way as an irritant (Fig. 8). It must be borne in mind that the reaction due to any injury such as inserting the tube will cause the appearance of some round cells which are not due to irritation or infection from the tube.

The second tube was left in place over eight weeks, and upon microscopic examination, with the exception of a small localized abscess, the surrounding tissue was normal, with no reaction such as is commonly seen around a foreign body (Fig. 9).

In the case where the third tube was inserted, there were signs of a hemiplegia soon after operation, and the rabbit died three days later with symptoms of intracranial pressure. At autopsy there was no visible hæmorrhage under the dura, as was suspected. The specimen was cut in serial sections with the tube in position, and some hæmorrhage was found along its tract, and within it were some fibrin and blood-cells, but no reaction to the tube itself (Figs. 10 and 11).

Fig. 12.

Five experiments of a similar nature were done on dogs, and in most of the cases the specimens removed at autopsy were preserved in gross, with the following results:

Where the celloidin was placed under the dura, at the expiration of two weeks it was found in one case that the dura was thickened and adherent to the cortex, except just over the celloidin sheet, where there were no ad-

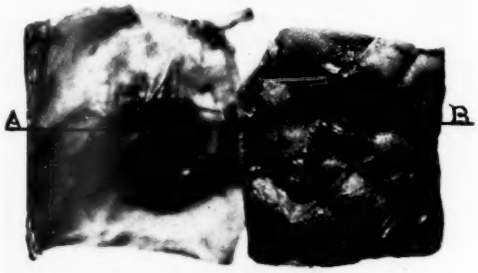

Fig. 13.

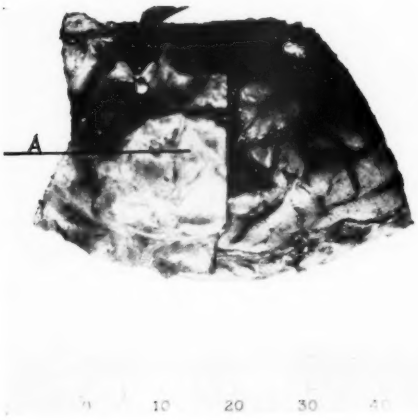

Fig. 14.

hesions at all (Fig. 12). In the second case, killed after the same interval, the celloidin had in some manner worked its way on top of the dura, which had not been sewn. The dura in this case was adherent to the cortex but there were no adhesions between it and the overlying celloidin, or of the latter to the brain at the point where the dura was open.

At the end of four weeks, in another case, the dura was found greatly thickened over the sheet, but was free and not bound down in any way to the cortex.

After five weeks, the condition was the same as found in the other cases, a thickened dura

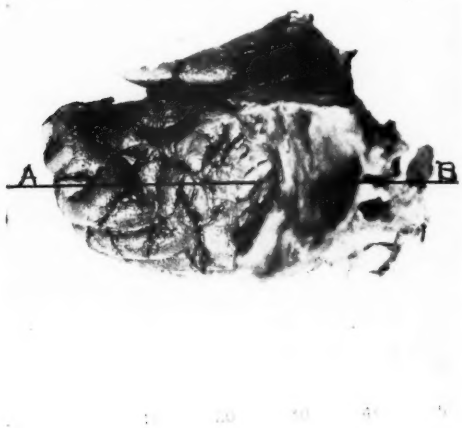

Fig. 15.

Fig. 16.

and no adhesions, and between the dura and cortex a glistening layer of connective tissue, quite unattached (Fig. 13).

One dog was kept for five months, at the end of which time, the celloidin was found encapsulated on both sides with a layer of connective tissue, which was smooth and glistening, and formed a pocket in which the celloidin lay, and yet left the cortex quite free of adhesions (Figs. 14 and 5).

Two animals were used as controls. One was kept for two months, celloidin being placed over, not under, the dura. In this the dura was thickened under the sheet, and densely adherent to the cortex, but not to the overlying muscles. The second was kept alive for five months and the adhesions between the cortex and the dura, where no celloidin had been interposed, were so dense that the cortex was torn in attempting to remove the dura (Fig. 15).

Tubes were inserted into only two dogs. The first died at the end of seven days, of

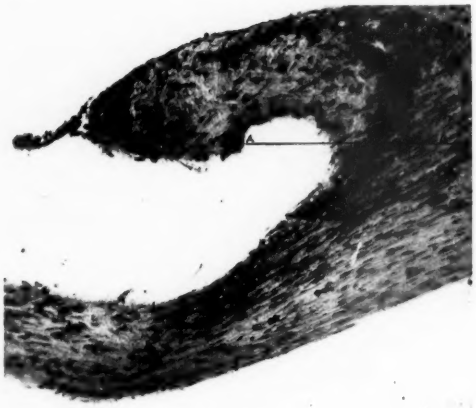

Fig. 17.

distemper. Serial sections were made of the cortex with the tube in position, and it was found free of adhesions to the brain substance, with some fibrin a short way into the tube. The brain walls showed no irritation (Fig. 16).

In the second case the tube was left in position for three months. At the end of this time no irritation could be seen.

In all of these cases where the dura was thickened, microscopic section showed connective tissue cells laid down (Fig. 17), which is quite different from the thin normal dura as it is ordinarily seen.

An effort was made, without any success, to obtain adhesions within the shoulder joint of dogs. In a number of cases the shoulder joint was opened and the articular surface of the head of the humerus scraped gently with a curette, and celloidin placed between the two articulating surfaces. In the only case where there was satisfactory healing the celloidin had remained in position, and the joint cavity was entirely free of adhesions at the end of ten days (Fig. 18).

Fig. 18.

Fig. 19.

In cases of nerve suturing, the results were most satisfactory. A nerve in the foreleg which had been cut across and sutured with fine silk, and a celloidin tube slipped over the point of suture, at the end of ten days showed no evidence of the nerve being bound down, but was free in the tube (Fig. 19), and at the end of six weeks another which had been wrapped with a piece of celloidin tissue showed a sheath of connective tissue which had formed over the celloidin, leaving the nerve healed and free beneath it (Fig. 20).

From the foregoing results the following conclusions have been deducted:

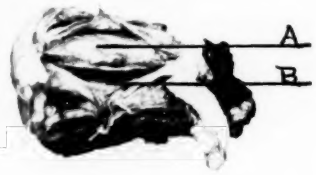

Fig. 20.

1. It is possible to use a non-irritating, non-absorbable foreign body in the potential body cavities and not produce adhesions.

2. Celloidin in properly prepared forms is such a substance.

3. In places such as the joints and cranial cavity, as well as around nerves, it can be used to prevent the formation of new adhesions or hinder the re-formation of old ones.

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ISOLATED DISEASE OF THE SCAPHOID BONE OF THE FOOT IN CHILDREN (KOEHLER'S DISEASE)

BY GEORGE E. PFAHLER, M. D., PHILADELPHIA

ISOLATED disease of the scaphoid bone, occurring in children, having peculiar characteristics, was first described by Koehler of Wiesbaden, in 1908, when he reported three cases of this disease. Since then six other cases have been reported by five different authors, Behn, Dobisch, Haenisch, Preiser, Schaffer, and because of its apparent rare occurrence, I take the liberty of adding the tenth case.

A boy, age 3½ years, was brought for examination by Dr. Robert Gamble, on April 18, 1913. During the past year, he has had three attacks of lameness in the right leg. The attacks came on suddenly, lasted for several weeks, and then disappeared completely. He complained of pain in the foot, particularly when he stepped upon it, and the pain was referred to the arch of the foot. There was with this some swelling and some tenderness. About two months before coming for examination, his attending physician recognized evidence of spongy and bleeding gums, which disappeared with the administration of lemon juice. Three weeks before coming for X-ray examination he had a fever of 104° F. with no noticeable evidence of joint disease. The child being confined to bed, a lame foot might have been overlooked. Otherwise the child was healthy, and well cared for. The parents were healthy, there being no history of tuberculosis, lues, or specific infection. No history of traumatism could be obtained.

X-ray examination of the foot showed the characteristic appearances previously described by Koehler, and consisted of an increased density of the point of ossification in the scaphoid, which is long and flat in shape. In this case it was only one quarter of an inch long, and one eighth of an inch thick, but the density was increased to about three times the normal; was rough in outline and less than one fourth the size of the scaphoid center of ossification in the healthy foot. (Fig. 1.)

Examinations of the other foot (Fig. 2), knees, and both hips were made and all found to be healthy. The brim of the acetabular cavity on the right side was slightly less dense than that of the left, otherwise none of the bones of the lower extremities showed anything abnormal. Dr. Alfred Stengel, who saw the child in consultation, says: "The child has a slight systolic murmur with no decided evidence of cardiac weakness or weakness of the general circulation. I am somewhat impressed in the history of the case with the attacks of fever, bleeding from the gums, etc., which would perhaps point to a general metabolic disorder."

In general, this disease, described by Koehler, shows in all cases a limitation to this one bone except in one of Koehler's cases in which a similar process was found in the patella of the affected side. In all the cases the disease occurred between the third and ninth year of age. All occurred in boys. Each of the cases reported by Haenisch, Schaffer, Preiser and Stumme, gave a history of traumatism. The general health of the patients was good. The most characteristic symptom is pain when the patient steps upon the foot, which causes lameness. There is

Fig. 1.

Fig. 2.

tenderness upon pressure over the scaphoid. A few cases showed swelling, and one localized heat. None had any constitutional symptoms.

Etiology. Preiser's two cases showed an injury of the child's foot by having a grown person step upon it. One of Koehler's cases, Schaffer's case and Stumme's case were supposed to have been injured while the children were playing, but there was no definite history of injury. In this case of mine there is no history of any injury. In one of Koehler's cases the parents were tubercular. In another, the father had gonococcus disease, preceding impregnation. Haenisch, Schaffer, Stumme and Preiser are of the opinion that the disease is of traumatic origin. Stumme states definitely that he believes the disease to be due to a compression fracture. Preiser believes that it is a disturbance of nutrition, due to traumatism. One of Koehler's cases was highly rachitic, and the father of this child had been rachitic, yet none of the other cases reported gave a history of rickets.

The case added by myself gives no history of traumatism; has had three attacks within a year, from which the child seemed to recover completely, and almost as abruptly as the disease appeared. When the child was seen on April 18, 1913, he could not be induced to place his foot upon the floor. When seen two days later, all symptoms of lameness and pain had disappeared. This is a strong argument against the disease being due to a fracture, for a fracture could not heal so abruptly. The abrupt appearance and disappearance would suggest rheumatism, but no other joints have been in any way involved.

All authors agree that it is not tubercular. The fact that a distinct sclerosis, indicated by the increased density of the ossifying center, is present, points to an inflammatory process. It would seem, therefore, that the disease is an osteitis, probably of traumatic or rheumatic origin, which interferes with the development of this bone.

Diagnosis. The diagnosis may be suspected when a child of some three to nine

years of age, complains of lameness in the foot, particularly affecting the arch, with perhaps tenderness and local swelling; and can be accurately diagnosed by an X-ray examination, especially if both feet are examined for comparison. The smooth, well formed outline of the ossifying bones of the healthy foot have the same density as the other bones, while in the diseased foot the ossifying bones are very much smaller, irregular in outline and several times more dense in proportion to its size than the healthy bones, and this density is in striking contrast to the remaining bones in the same foot.

Prognosis. Koehler says the disease is liable to extend over a period of two or three years. The cases recorded existed for several months before a physician was consulted.

The case reported by Stumme lasted from the third of May, 1909, to February, 1910, when the child had recovered completely, both symptomatically and in the reformation of this bone, as shown by X-ray examinations.

Several of the cases reported have been studied until they have completely recovered, and X-ray examination made later showed no trace of the former disease. The scaphoid gave a normal appearance.

Treatment. The treatment of these cases has not been fully described, but the case reported by Stumme had been placed in a plaster cast for four weeks, and then removed and massage given for four or five weeks more, at the end of which time the child had completely recovered. Schaffer's case recovered under rest and massage. It would seem, therefore, that this would be the rational procedure, on the theory that this is a traumatic osteitis, or, as he states, a compression fracture.

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DEPARTMENT OF TECHNIQUE

A MODIFICATION OF WEBSTER'S ENDOPERITONEAL SHORTENING OF THE ROUND LIGAMENTS

By HENRY SCHMITZ, A. M., M. D., Chicago

THE endoperitoneal shortening of the round ligaments according to Webster's method has many advantages and disadvantages in comparison to other intra-abdominal methods. The advantages are: The method is surgically very easily executed; it leaves the uterus in an absolutely free and suspended position within the pelvis; by attaching the loops of the round ligaments low down on the posterior surface of the uterus, the latter is placed quite forward toward the symphysis pubis, and thereby the function of the sacro-uterine ligament to suspend the cervical portion of the uterus within the pelvis is materially increased, on account of the increase in distance between the cervix and sacrum; further, by looping the round ligament underneath the utero-ovarian ligament, the round ligament is made to elevate the position of the ovaries within the pelvis; finally, Webster's method does not interfere with the Fallopian tubes, and it does not displace nor acutely bend the tubes, as is the case in other intra-abdominal methods, viz., the method of Menge-Stolz.

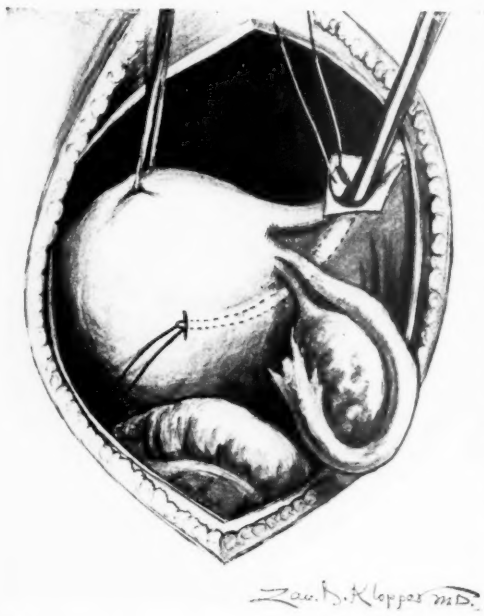

Fig. 1. Schmitz's modification of Webster's intraperitoneal shortening of round ligament. Round ligament exposed and divided; suture passed through distal end.

The great disadvantages of Webster's method are that it depends for its success on a sero-serous agglutination between the round ligament loop and the uterus. It therefore does not give an absolute guarantee for a permanent result. It also makes use of the strongest part of the round ligament for the looping, relying on the weak and shorter portion to assume the work of the normal round ligament.

Alfieri[1] recommends a modification of Webster's operation as follows: He exposes the round ligament by a lateral and forward displacement of the uterus. A transverse incision is made in the peritoneal covering over the ligament about 3 to 4 cm. laterally from the uterus. The ligament is severed, then freed distally. A ligature is attached to the distal end of the ligament to serve as a guy rope. An opening is made in the posterior layer of the broad ligament between tube and ovarian ligament. A forceps is attached to the distal portion of the round ligament. By means of the forceps the ligament is carried between the layers of the broad ligament and out through the opening in the mesosalpinx. An incision is made on the posterior surface of the uterus, and the round ligament is secured within this incision by several silk sutures. The same process is repeated on the other side. Finally the proximal portion of the round ligament is stitched to the distal portion about the first peritoneal incision. The latter is then closed.

[1] Gynäk. Rundschau, vi, 21.

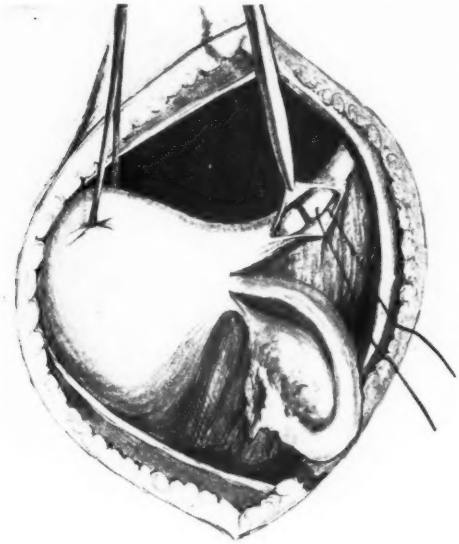

Fig. 2. Schmitz's intraperitoneal shortening of round ligament — second step. Suture passed between folds of broad ligament underneath uterine tube and ovarian ligament to middle of posterior wall of uterus.

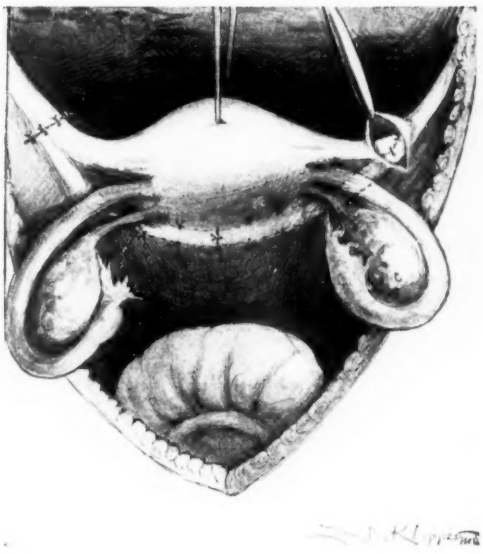

Fig. 3. Schmitz's intra-abdominal shortening of round ligament — operation finished. Proximal stump of round ligament attached to distal portion; peritoneum closed. The round ligament is entirely covered with peritoneum. It obviates a sero-serous attachment.

The modification which I propose and have already executed in a few cases is as follows: I attach a Barrett ligature carrier to the ligature applied to the distal end and carry it between the layers of the broad ligament to the posterior surface of the uterus underneath its peritoneal covering. I make a very small perforation in the center of the peritoneal covering to enable me to catch the ligature and thus hold the ligament in position. The same procedure is now carried out on the opposite side. The two ligatures are tied, uniting the two ends of the round ligaments. The latter are finally secured to the posterior wall of the uterus by a few interrupted fine chromicized catgut stitches. These should only include a portion of the round ligament, to prevent gangrene of the same. Finally the proximal end of the round ligament is attached to the distal end as in the Alfieri modification, and the peritoneal incisions are closed. The round ligament now has the form of a Y (Figs. 1, 2, and 3).

The advantages claimed for my modification are: 1. The ligaments remain entirely extraperitoneal. 2. There is a muco-muscular attachment between the uterine mucosa and the denuded round ligament. 3. The method does not use the strongest portion of the round ligament for the shortening, hence the functional ability of this ligament is as nearly normal as possible.

EIGHT DRAWINGS ILLUSTRATING THE STEPS OF SUPRAPUBIC PROSTATECTOMY [1]

By GUSTAV KOLISCHER, M. D., Chicago

I

Anterior aspect of bladder exposed, the peritoneal reduplication detached by gauze dissection, the punctuated line marking the incision opening the bladder.

II

The bladder opened and its interior exposed by occipito-caudal traction. U, internal urethral orifice. P, prostatic protrusion.

III

Prostate fixed by tumor screw T. The prostate exposed by trigonal incision J. The edges of this incision are secured by two guy-ropes GG, which are used for clearing bottom and edge of this incision in order to definitely check the hæmorrhage after the enucleation of the prostate is completed.

IV

Prostate delivered into the bladder cavity previous to the severing of the urethra.

V

Arrest of hæmorrhage by enclosing sutures in bottom of former site of prostate and by hemstitch taking care of edge of trigonal incision.

VI

The bladder closed, drainage tube secured in upper angle of incision by purse-string suture.

VII

Glass coupler C inserted into drainage tube.

VIII

Glass coupler connected with tube leading into receiving vessel which is filled up to one third with fluid, thus establishing permanent syphonage; the protruding of the glass coupler out of the dressing permits of control of syphonage.

Plate I.

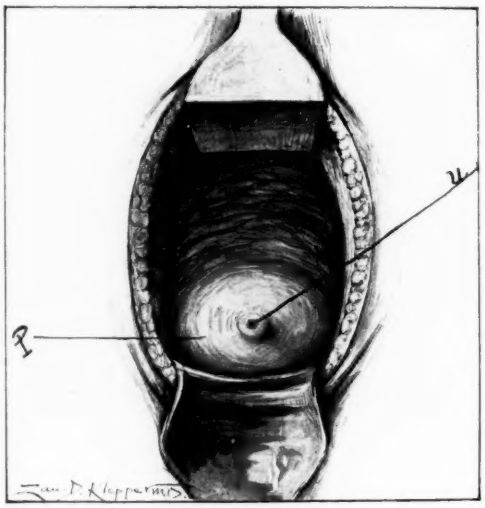

Plate II.

[1] Compare "Technique of Suprapubic Prostatectomy" in the October, 1912, number and "The After-treatment of Suprapubic Prostatectomy" in March, 1913, number of this journal.

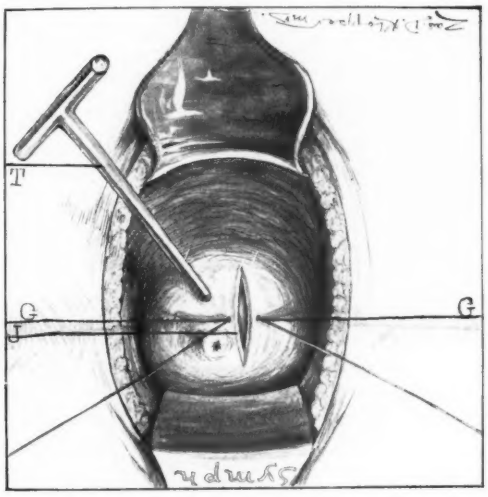

Plate III.

Plate IV.

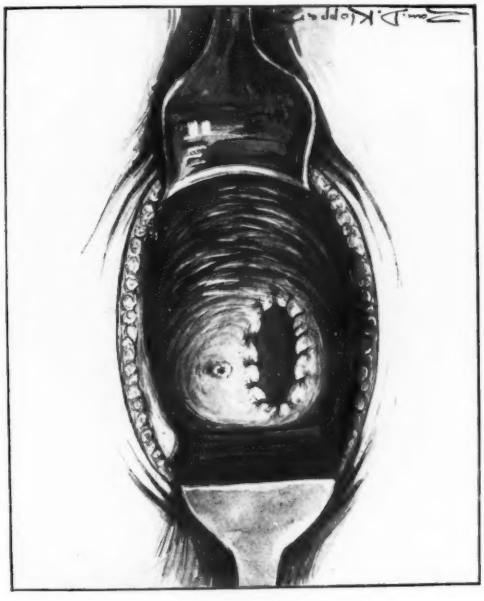

Plate V.

Plate VI.

Plate VII.

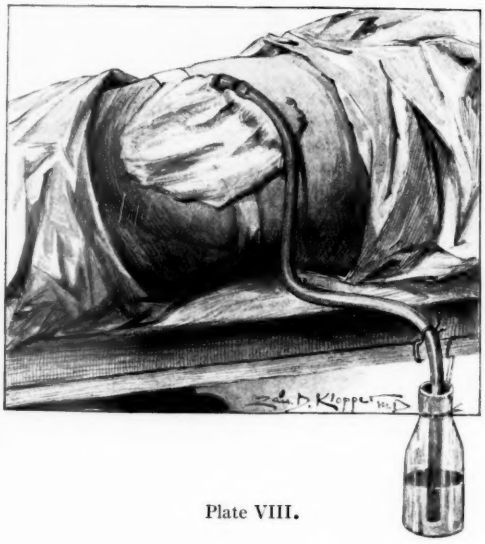

Plate VIII.

THE DRESSING AND CARE OF HERNIOTOMY WOUNDS OF INFANTS AND SMALL CHILDREN

By COLEMAN G. BUFORD, M. D., Chicago
From the Surgical Service at the Children's Memorial Hospital

IN order that my position on the hernia question be made perfectly clear, I wish to state that I do favor routine herniotomies on older children and on healthy adults not too advanced in years. I do not favor herniotomies on infants and young children, unless one or more of the following indications exist:

1. Irreducible or strangulated hernia.
2. Herniæ not retained by properly fitting trusses of proper design.
3. Herniæ in children upon whom truss treatment, properly and continuously applied for two years, has failed.
4. Herniæ in children whose parents cannot be educated to the proper use of a truss.
5. Herniæ in children whose parents insist upon operation.

All infants and small children suffering from hernia and not presenting one or more of the foregoing indications should have their operations deferred until such a time when their age and state of intelligence will permit of them controlling their emotions and aiding in the control of their excrement.

Several years ago it seemed that the question of whether or not to operate as a routine upon infants and small children suffering from uncomplicated inguinal hernia was definitely settled in America, largely through the writings of Bull and Coley, whose wealth of material in the New York Hospital for Ruptured and Crippled afforded them a rare experience. Their views are in support of the London Truss Society, which has also made a most exhaustive clinical and statistical study of this question. But within the last few years there has been a growing tendency to operate on these cases without sufficient regard for the teachings of those who have had vast opportunities to observe results obtained in young children by means of truss treatment, as well as the dangers associated with the operation. I cannot refrain from expressing the belief that the swing of the pendulum toward the popularization of routine operations for uncomplicated inguinal hernia in infants and young children is born of over-enthusiasm, too great an anxiety to operate, and lack of experience with the truss and lack of experience in pediatric surgery. The belief pre-

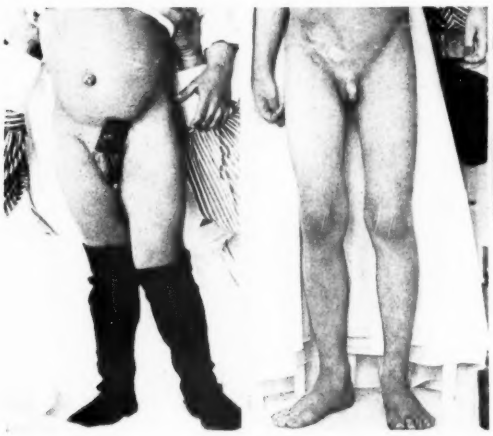

Fig. 1. Thin, narrow gauze pad covered by one layer of gutta percha sealed to skin with collodium. Dressing is usually made a little more narrow than shown in picture; especially in larger children, does not reach quite so near genitals. Gauze coverings are made in the same shape.

Fig. 2. Cotton-collodium dressing with underlying absorbent pad which is not impregnated with collodium. Edges of cotton covering frayed to great thinness and sealed to skin. Additional coats are smeared over entire surface to render it more waterproof.

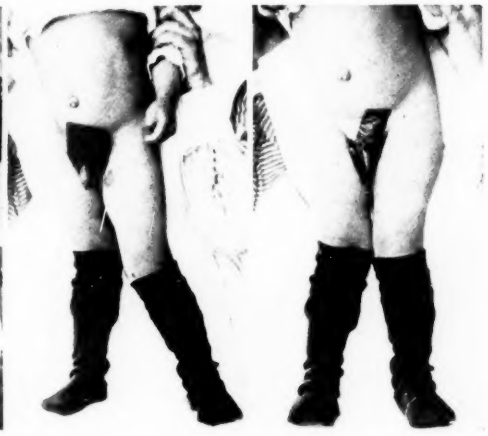

Fig. 4. First step in sealing sheet of gutta percha to pubes.

Fig. 5. Shows sheet of gutta percha folded downward and about penis, directing urine away from hernia wound.

vails that infants are relatively safe operative risks, but this is not true; on the contrary, the percentage of fatalities among infants anæsthetized for all surgical reasons is alarmingly large. This is partly due to the serious afflictions among them requiring surgical attention, often to the advanced stage of the malady before a diagnosis is made, the infants' susceptibility to gastro-intestinal disorders when invalidized or hospitalized and to pneumonia following anæsthesia.

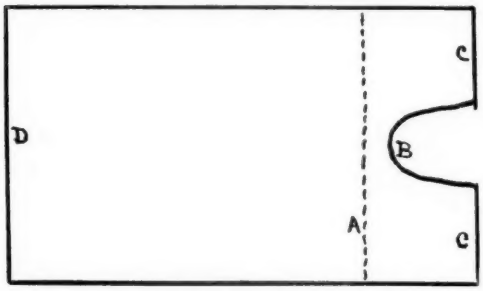

Fig. 3. A rectangular piece of gutta percha notched at (b) for reception of base of penis is placed upon pubes; the sides (c) extend downward on either side to upper part of scrotum. Side (d) still remains upward. All of gutta percha lying below line (a) is sealed to pubes and scrotum. When dry the free portion above line (a) is folded downward over penis (Fig. 4). All below line (a) is covered with collodium and sealed to the opposing surface, thus giving the apron greater security.

In addition to these risks, their excrement, especially the urine, makes the danger of infection of wounds in the lower half of the trunk and the thighs much greater than in adults. This is due to the conveyance of infection into the skin by way of the sutures through capillary attraction and thence to the deeper layers, to chemical changes occurring in the urine after it has infiltrated the suture material and tissues, thus acting as a local irritant and inviting the centralization of the infection; stitch abscesses ensue, or very commonly almost no pus appears, but granulation tissue invades the stitch holes and the line of incision and serious damage results. The

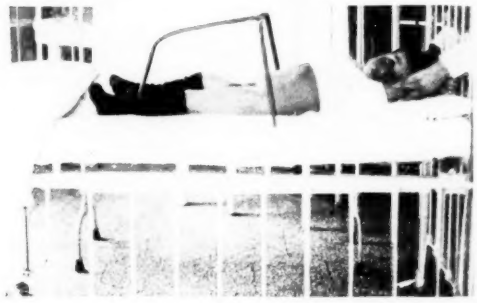

Fig. 6. Herniotomized child dressed for bed. Cradle to keep covers from dressings and from becoming wet with urine.

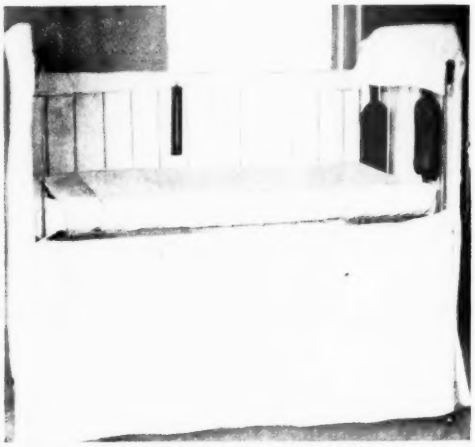

Fig. 7. The temperature of the bed is watched. Hot water bags used as radiators in colder weather.

child may die of infection or the intention of the plastic operation may be defeated through the necessity of removing all the sutures and opening wide the wound to facilitate drainage.

Much time and space has been given in writings upon the various methods of operating upon infants for hernia, but the matter of how to dress these wounds in infancy and early childhood and how necessary it is to give them scrupulous attention until every abraded area has healed so as to protect them from contamination by their own excrement, has been sadly neglected, yet it is the most important point connected with the subject. Let us answer frankly to ourselves this question: If we were to herniotomize an infant this hour, how would we go about protecting its wound from urinary and possible fœcal contamination?

Before undertaking herniotomies on infants to any extent in the Children's Memorial Hospital, I endeavored to ascertain what protective dressings were in general use elsewhere and what precautions were taken. I was told the gauze pad retained by a spica bandage was used in one institution, the simple collodium or benzoin seal in another, and in addition to these test tubes, flasks, or condoms were suggested, strapped to the genital of the males, for the purpose of collecting the urine. It did not take long to convince me that an ordinary gauze or spika dressing was sure to be wet by the babe sooner or later, and the collodium or benzoin seal prevented evaporation when applied next to the wound, and if no real stitch abscesses occurred at least the suture canals

Fig. 8. Hernia pajama (Children's Memorial Hospital).

were not always as dry as they should be on first exposing the wound and required a long time to heal, or often granulation tissue had invaded the suture canals and the line of incision and late suppuration occurred. The test tube, flask, or condom attachments to the genitals are too easily dislodged to be trusted in the neighborhood of so important a wound as that of a herniotomy where a cure depends largely upon primary union, and infection may mean, in an infant, prolonged hospital and bed detention and even death. We set about not to find something new, but to use everyday methods and to perfect the details of dressing and caring for these cases with a view of giving the most certain results. After drying the already sutured wound, a pad of gauze or cotton just sufficient to absorb any oozing likely to follow is applied. We usually use about four layers of gauze. In either case the absorbing pad barely extends beyond the ends of the incision and just outside of the stitch holes, and is covered by one of the following, preference being given in the order they are named:

Gutta percha, collodium.

Gauze, collodium.

Cotton, collodium.

To promote flexibility of the dressing, a covering of only one layer of gutta percha or gauze is used, cut in rectangular shape, large enough to

well overlap the absorbent pad, around which collodium is thinly spread upon the skin and the covering quickly applied and held down until fairly dry. Exuding collodium is scraped away while moist. Cotton coverings are applied in the same manner, but their edges are first frayed out to great thinness. Gauze and cotton coverings, after being sealed on, are smeared with a thin layer of collodium sufficient only to fill the meshes of the top layer and not allowed to penetrate the underlying pad. After drying, it acts as a base for future coatings, preventing their penetration. The wound must not come in contact with the collodium. After drying, the edges of these dressings are coated with layers of thinly applied collodium, each layer extending over the edge of the preceding one. Gauze and cotton dressings are entirely coated over with several layers of collodium, with a view of rendering them more durable and waterproof. The gutta percha covering is made more durable by the same treatment. We endeavor to make each dressing as small as possible for we have found the larger they are the more the edges peel up. In the use of collodium, to secure a small but strong dressing, apply with a dry glass rod or narrow, flat instrument. Avoid the use of cotton swabs because they fray the edges or while the dressings are moist may pull them off (Figs. 1 and 2).

Our efforts do not end here. We attempt to direct the urine away from the dressing. After meeting with failures in accumulating it in test tubes, condoms and urinals, and finding that we could not trust even the larger children who were called upon at short and irregular intervals to urinate, we adopted the use of what we term the water shed, consisting of a piece of gutta percha tissue (oil silk or thin dental rubber might prove saisfactory, though we have not used either), which is cut according to Fig. 3, with a view of sealing it to the pubes above the genitals and to allow it to dip well downward into the inguinal fold on either side. The method of application is best seen in the illustration (Fig. 4). This shed diverts the urine from the wound when involuntaries occur but the material crinkles and is insufficient if not kept spread out. It must be examined often and changed in a few days.

Even this precaution would not insure dry wounds were it not used on children properly dressed and the bed coverings properly arranged and cared for. The garments of infants are rolled or cut off at or above the level of the navel where they are drawn snugly with a drawstring or secured with safety pins. Stockings or leggings may be worn, but in no case a diaper (Figs. 5 and 6).

All infants are put in a bed we use for open air treatment of burns, which in the hospital is known as the burn bed. The winter burn bed is used because of its warmth and freedom from draughts. The object of keeping infants in such a bed is to obviate the need of covers which are dangerous articles about their hernia wounds on account of the danger of them getting wet with urine, ever being displaced and tending to wipe off the dressing. The child is not restrained, but is given the freedom of the bed. On account of the recent operation and the habit of restraint, rarely does a child under a year old sit up during convalescence, but rolls about with freedom (Fig. 7).

Larger children who are intelligent enough to be reasonably still are dressed in a similar manner, but more recently we have adopted the use of the hernia pajama (Fig. 8). All covers for older children are lifted by a frame so that should the child have involuntary urinations, the wet covers will not come in contact with the dressing on the wound (Fig. 6).

When for any reason the child should be restrained, this is done by use of the Bradford frame, a humane form of restraint. We used this method as a routine in hernia work among children for a time, but abandoned it because results appeared satisfactory without restraint. One should understand how to make up the frame and the method of properly and humanely restraining a child on it.

THE VALUE OF THE D'ARSONVAL CURRENT IN THE TREATMENT OF BENIGN AND MALIGNANT TUMORS OF THE URINARY BLADDER THROUGH THE OPERATING CYSTOSCOPE

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IT is conceded that the surgical treatment of tumor of the urinary bladder is a failure. In a paper previously published,[1] I quoted F. S. Watson,[2] who gives a complete résumé of six hundred and eighty cases. His conclusions are appalling. In May, 1910, Beer[3] first submitted his results with the Oudin current in the treatment of papillary tumors of the urinary bladder. In the meantime, a number of urologists employed this current. Beer quoted their results in a paper read before the Genito-urinary section of the American Medical Association, June, 1912. I, too, successfully used the Oudin current on several cases at the Clinical Congress of Surgeons of North America, held in Philadelphia in November, 1911, and subsequently published my results.[4] Shortly afterwards, however, a tumor, suspiciously malignant, not only failed to respond to this current but grew with alarming rapidity in the interval between treatments. This lead me to employ the D'Arsonval current. With it the growth was temporarily controlled, the hæmaturia and cystitis decreased. Previous to employing it on this patient, I had conducted a series of experiments with both the Oudin and D'Arsonval current on raw beefsteak and liver. The results lead me to adopt the D'Arsonval current in all subsequent cases. It is really surprising what slight mention one sees of the use of this current for tumors of the urinary bladder. I observed that in the leaflet which Beer distributed at the last meeting of the American Medical Association I was the only one quoted as giving preference to it. Keyes[5] referred to its value in ameliorating the symptoms in a malignant case, and Pilcher[6] mentions its use in a case following suprapubic excision of a large growth.

By perusing the report of my cases, together with the results of my experiments on raw meat, my reasons for selecting this current can be readily understood.

Experiments with the D'Arsonval current. For experimental purposes, I selected a piece of raw beefsteak, seven and a half centimeters square and one centimeter thick. The meat was laid on a metal plate connected to one terminal of the machine and an area twenty-five mm. in diameter was marked out. The insulated copper wire was exposed one cm., its proximal end attached to the other terminal and the distal end plunged into the meat to a depth of one mm. The current was turned on four hundred ma., with the rheostat on the third button, for fifteen seconds. This dessicated an area ten mm. in diameter and one mm. in depth. (At two hundred ma. it dried the same area superficially.)

The wire was withdrawn and inserted at a point about five mm. from the original insertion. The second application of fifteen seconds duration dessicated to a depth of one mm.

The third application of fifteen seconds duration dessicated another area to the same depth.

The fourth application of the same duration, caused a general charring of the previously burned areas.

The fifth application increased the size of this charring.

The sixth application likewise increased it.

The seventh application completely charred the entire area previously mapped out, to a depth of one mm.

An application of ninety seconds duration with the current at four hundred and twenty-five ma. and the rheostat on the third button burned the same extent of area to a depth of one cm.

Experiments with D'Arsonval current on raw liver. A piece twenty-five mm. in diameter and fifteen mm. in depth was selected. The strength of the current used was the same as in the foregoing experiment.

The first application burned an area five mm. in diameter and one mm. in depth.

The second application increased the size of this area.

The fifth application entirely dessicated the area mapped out.

The same experiments were likewise conducted on raw liver and raw beefsteak under water. It was found that it required a current of from four hundred and twenty-five ma. to four hundred and fifty ma. to produce results similar to those ob-

[1] Hahnemann. Month., 1910, March.
[2] Watson and Cunningham, Genito-Urinary Diseases.
[3] J. Am. M. Ass., 1910, May 28.
[4] Hahnemann. Month., 1911, September.
[5] Keyes, Surg., Gynec. & Obst., 1913, Jan.
[6] Am. J. Surg., 1913, April.

tained when the meat was attacked in air. Therefore, it was seen that in order to obtain perfect results through the cystoscope on tumors of the urinary bladder, a current of not less than four hundred and twenty-five ma. must be employed.

Experiments with the Oudin current. Similar experiments were also conducted with the Oudin current with the rheostat at the third button, the wire being inserted one mm. into the meat.

An application of fifteen seconds had no effect whatever.

One of sixty seconds, using the same current, merely charred the meat, producing a puncture one mm. in diameter.

The same current applied for two minutes charred an area two mm. in diameter but of little depth.

The rheostat was switched on to the fifth button, continuing the application for fifteen seconds. This produced a hole two mm. in diameter. Prolonging it for sixty seconds made but little difference in the dessication. In all, it took about twenty-five applications to burn the selected area superficially. It can then be seen that it would require a great many treatments to destroy a growth twenty-five mm. in diameter.

Experiments with the Oudin current on raw beefsteak under water were also conducted. Here, too, it was found that a stronger current was necessary to accomplish the same amount of destruction as when the experiments were made in air. The lesions made while experimenting with the Oudin current resembled herpetiform vesicles.

The Oudin current also acts more powerfully on raw liver than on raw beefsteak. When the wire was not introduced into the meat but held close to it, herpetiform blisters were produced.

A piece of raw beefsteak, twenty-five mm. in diameter and fifteen mm. in thickness was selected The wire was plunged 1 cm. into the center, the current turned on four hundred and fifty ma. with the rheostat at the third button. The area was treated for fifteen seconds. This burned an area three mm. in diameter and entirely through the thickness of the meat. Under water, it produced a burn similar in character three mm. in diameter but only 1 cm. in depth.

From the above experiments it can readily be seen that the Oudin current, when applied through the cystoscope, has but a limited field of usefulness, such being confined to small papillary tumors. When dealing with larger growths or those suspiciously malignant, the D'Arsonval current is distinctly indicated. Indeed I have seen growths proliferate rapidly under the Oudin current. This can be readily explained by recognizing the fact that this current does not dessicate, but actually furnishes sufficient heat and moisture to feed the growth. For this reason, I now always employ the D'Arsonval current for benign tumors as well, since with it one takes no chances.

It will then be seen that the character and size of the lesion should determine the strength of the current to be used, and the depth to which the wire should be projected into the growth. It has been my experience that from one to two mm. is sufficient for perfect work, since lesions are rarely more than from five to ten mm. in thickness.

TECHNIQUE

The technique which I employ for these cases is as follows: The patient is prepared as for a cystoscopic examination. A sheet of asbestos is placed under the leather cushion on the table and the steel foot stirrups are likewise protected. A metal plate, five by eight inches, is strapped to the body by linen tapes, the position of the plate corresponding to the location of the tumor. For instance, if the tumor is located on the left side of the bladder, the plate is placed on the left side of the abdomen; if on the fundus, it should be placed on the abdomen immediately over it; if on the floor of the bladder, the plate should be placed under the buttocks. The cord from the plate is returned from one terminal of the solenoid, and from the other terminal of the solenoid the lead is to the cystoscope. The machine used is the Wappler high frequency apparatus. It is desirable to work in an operating room which has a wooden floor, since one covered with cement may short circuit and cause a slight shock.

A number of cystoscopes are really necessary. A Nitze examining with Zeiss lens, corrected vision, because of its magnifying properties; a straight vision Brown-Buerger type; a Nitze and a Wappler catheterizing. It may be necessary to use an operating cystoscope when one wishes to obtain a piece of tissue for microscopical examination. Of the above cystoscopes, the Wappler single barrel is the one I prefer, since the bladder may be thoroughly cleansed through it while in position.

The accessory instruments are an irrigating stand, portable electric light and a varied assortment of catheters.

Treatment. The patient, being in position, the operator sits in front, the assistant standing to his right and a nurse is to the left, rendering whatever assistance may be necessary. I usually locate the tumor with a Nitze and then introduce the

Wappler for operating. The insulated copper wire is inserted into the catheter tunnel of this cystoscope and projected from one mm. to five mm. according to the depth of the tumor, into the center of the growth. I then signal the assistant to turn on the current. The first application should last fifteen seconds, employing two hundred and fifty ma., then a rest of fifteen seconds is given without withdrawing the wire. The operator then notices the amount of charring which has taken place. The current is again turned on employing three hundred ma. and slowly raising it to three hundred and fifty ma., continuing it for fifteen seconds. Another rest of fifteen seconds is given and the wire withdrawn and examined. Should there be any tissue covering it, it is to be saved for microscopic examination. A new piece of wire is then exposed and projected into the growth. Usually for the third application a new site is selected at a point directly opposite the area first attacked. As the patient grows accustomed to this treatment, the miliamperage as well as the rheostat can be increased, giving the full strength of the current necessary for complete dessication, namely four hundred and fifty ma. In some cases I have switched the rheostat on to the fourth button and increased the miliamperage to five hundred and twenty-five ma., allowing this current to be directed to the growth for a period as long as forty seconds. Indeed, each case appears to be a law unto itself as regards the amount of current used. Some complain of severe distress at three hundred and fifty ma. with the rheostat on th esecond button, while others can stand a much stronger current without complaint. Each seance should consist of at least six applications of fifteen seconds each, with a rest of fifteen seconds between, and at least two areas should be treated. The fluid in the bladder may become uncomfortably warm, its temperature has been found to vary from 105° to 115° F. Before withdrawing the cystoscope, the fluid is allowed to drain into a sterilized glass receptacle and any shreds are saved for examination. The bladder is then irrigated with a boric acid solution. It may however, be necessary to snare off a specimen of tissue with the Rongeur forceps for diagnosis. In order to know the amount of work accomplished, I always employ a magnifying, examining cystoscope.

As a rule, unless we are dealing with carcinoma, there is very little if any reaction. To be sure, there may be some pain but this can be readily controlled with anodynes. There may also be a slight elevation of temperature. Following the treatment, the patient retires to a recovery room, or, if in the hospital, may rest in bed for an hour or two. Sometimes in carcinoma we have a severe reaction, such as rapid rise of temperature, pulse and constitutional symptoms. These however usually disappear quickly.

The amount of reaction, namely temperature rise, pain, urinary frequency, burning and distress must be the guide for the repetition of treatment. Ordinarily I resume treatment within a week. In some cases, however, every ten days according to the extent and character of the tissue involved.

We should always be on the lookout for daughter tumors, remembering the possibility of papillary involvement of the ureters and kidneys, these sending off shoots to the bladder. Therefore it is advisable to cystoscope these patients at intervals for a number of months.

CASE 1. G. A., age 38, merchant, patient of Dr. Hughes, Atlantic City. Diagnosis, papilloma vesicæ. D'Arsonval current employed five times; report eighteen months later cured.

History. Case was referred with a history of hæmaturia which had existed for three months. His appearance suggested tuberculosis. Cystoscopy showed a papilloma about twenty mm. in diameter, attached to the bladder by a very short pedicle, situated to the right and below the right ureteral orifice. Other portions of the bladder wall were free from disease.

The first treatment was given November 23, 1911, using the D'Arsonval current. In all, six applications were made, lasting fifteen seconds each, and with an interval of fifteen seconds' rest between each.

At the first application the wire was plunged directly into the center of the growth to a depth of one mm., and a current of two hundred and fifty ma. employed with the rheostat at the third button.

The second application was made at the same site without removing the wire, the current being increased to three hundred ma. The wire was then removed and a new location was selected directly opposite the original one. At this application the strength of the current employed was three hundred and fifty ma. Four hundred and twenty-five ma. was the current employed for the fourth application. The fifth and sixth were similar to the above excepting that a new portion of the growth was attacked.

At the termination of the treatment, an inspection with the magnifying cystoscope showed plainly the dessicated areas. The patient experienced very little distress either during or after the treatment. A rise of temperature to 100° F. followed, which may have been attributed to urethral instrumentation. The hæmaturia diminished following the treatment. The bladder was irrigated daily with a saturated solution of boric acid through a soft rubber catheter.

The second treatment was given four days later. It consisted of six applications of fifteen seconds each with intervals of fifteen seconds' rest between each application, using at this time a current of four hundred and twenty-five ma. A third and similar treatment was given four days later, and four days afterwards a fourth treatment. At the fifth treatment, it was seen that very little of the growth remained but the remaining areas were treated. One week later cystoscopy showed nothing but a scar at the former

site of the tumor. Very little distress or reaction was associated with or followed any of the treatments.

Six months later I made a cystoscopic examination and the bladder was free from lesions.

Eighteen months later the patient reported that he felt perfectly well.

CASE 2. Miss A., age 50, patient of Dr. Mary Cook of Philadelphia. Diagnosis: Sessile papilloma vesicæ and a daughter tumor at the edge of the right ureteral orifice. Treatment: The D'Arsonval current was employed six times. Sixteen months later no recurrence.

History. Patient consulted me December 30, 1911, for right-sided kidney ache together with frequent and painful urination which had existed for two years. She was compelled to urinate several times during the night and hourly by day. Had one attack of hæmaturia December 26, 1911. She was short and plethoric, blood pressure of 180°. The climacteric had been passed. Her general appearance was good.

Cystoscopy revealed a sessile papilloma about fifteen mm. in diameter at the trigone, almost equidistant between the ureteral orifices, elevated above the bladder wall approximately about two mm. A small central area of ulceration was seen. I touched it with the ureteral catheter, it conveyed the impression of hardness. A small warty daughter growth, about two mm., was situated to the right of the under lip of the right ureteral meatus. Both the cystoscopic and the clinical picture were suggestive of malignancy.

The radiograph showed nothing abnormal in the right kidney.

On January 3, 1912, the first treatment with the D'Arsonval current was given. The wire was projected directly into the center of the growth to a depth of one mm. with the rheostat at the third button. The current was turned on three hundred ma. for fifteen seconds with an interval of fifteen seconds' rest. At the next application the current was turned on to three hundred and fifty ma. gradually raising it to four hundred and twenty-five ma. Six applications in all were given at the first treatment. Some pain was experienced during the treatment and a slight reaction, a rise of temperature to 100° F. followed in the evening. The second treatment was given nine days later. The third treatment was given two weeks later. The fourth treatment was given one week later. The fifth treatment was given eight days later. The sixth treatment was given three weeks later. At each treatment cystoscopy showed areas of dessication and decrease in the size of the tumor.

On March 14, 1912, cystoscopy showed very little to attack in the original tumor; I therefore projected the wire into the smaller growth at the right ureteral orifice to a depth of one mm., giving three applications of four hundred and twenty-five ma. with the rheostat on the first button, lasting fifteen seconds.

The next day the unexpected happened. I was summoned to prescribe for painful and profuse hæmaturia. The reaction was distinctly bad. The temperature rose to 103° F. and the pulse to 110. She vomited frequently and complained of severe pain referred to the right kidney, bladder, ureter, urethra and thigh. She was compelled to remain in bed one week and suffered another severe attack of renal colic and hæmaturia. Recovery followed. Examination of the urine at this time failed to show any characteristic tumor cells. The patient decided to omit any further treatment for a while. This was fifteen months ago. I cystoscoped the other day, there was nothing but scars at the site of the original tumors. The cystitis is much improved, while the renal distress is troublesome only after a very busy day. The behavior of the case is quite remarkable. The question which naturally arises is what condition previously existent in the right kidney or ureter was awakened by the current directed to the papillary growth at the right ureteral orifice? It will be decidedly interesting to watch the outcome of this case. Sixteen months have passed and the patient is quite comfortable.

CASE 3. M., age 61, retired, patient of Dr. Silas Quint of Camden, N. J. Diagnosis. Pedunculated villous papilloma vesicæ. Treated with D'Arsonval current, giving four treatments in all. Result, cured.

History. The case was referred because of cystitis and an intermittent hæmaturia of four weeks duration. For several years he was compelled to arise twice during the night to urinate. The act was also unduly frequent during the day. The general appearance of the patient was not good. He was anæmic and coughed frequently during examination. His physician assured me that the chest was free from tubercular involvement. Examination of the sputum was negative for tubercle bacilli. The specimen of tough mucus showed some pus and a little blood. Various pyogenic bacteria were found. He had had attacks of bronchitis in the spring and fall for the past fifteen years. He was an inveterate smoker and fond of alcohol.

Urinary analysis: Specific gravity 10.25; alkaline reaction, urea normal, albumin, pus, mucus and blood cells. No renal casts nor cells were found.

There was a moderate enlargement of the prostate and two ounces of residual urine.

Cystoscopy revealed a pedunculated villous papilloma, fifteen mm. in diameter, below and to the left of the left ureteral orifice, moderate trabeculation and areas of congestion. The bladder was irrigated with nitrate of silver 1–5,000 for several days preparatory to the high-frequency treatment.

The first treatment was given May 3, 1912, the wire being projected one mm. into the center of the growth. At this time six applications were made. There was very little reaction. The bladder was irrigated daily with nitrate of silver 1–5,000. One week later a second treatment was given employing the usual technique. The hæmaturia ceased after this treatment and the urinary act became less frequent and annoying. Severe constitutional reaction followed the second treatment. The temperature rose to 103° F. and the pulse to 108. This however passed off in a few days. In all four treatments were given at weekly intervals. He then left for the seashore where he died three months later from pulmonary disease. The attending physician assurred me that the urinary symptoms had not been especially annoying.

CASE 4. W. J., age 70, retired, patient of Dr. Furman of Philadelphia. Diagnosis: Sessile papilloma vesicæ. Treatment with D'Arsonval current, eleven treatments in all. Result, cured.

History. The patient was referred on March 7, 1912, with the following history: For the past two years he had been compelled to arise several times at night to urinate. Urination was also unduly frequent during the day. He complained of suprapubic and perineal distress as well as pain referred to the right thigh.

The lateral lobes of the prostate were enlarged and the bladder contained two ounces of residual urine.

The urine was of amber color, the specific gravity 10.10 and the urea slightly below normal. A small amount of pus and blood were present.

Cystoscopy showed a sessile papilloma, twenty-five mm. in diameter, situated at the base of the trigone between the ureteral orifices. While preparing the bladder for cystoscopy, some bleeding occurred. It frequently occurs under similar circumstances. The behavior of this case was re-

markable since there was no reaction following any of the treatments. He had eight seances within sixty days, at the end of which time the growth had disappeared. On May 22nd, cystoscopy showed that two small areas had not been destroyed. I resumed treatments, giving in all three more, the last being on June 30th. Since that time he has been free from urinary symptoms. I cystoscoped him the other day and could see no evidences of the growth.

CASE 5. Miss A., age 40, patient of Dr. Williams of Landale. Diagnosis: Papillomata vesicæ and pyelitis. Case still under treatment.

History. Patient was referred to me on February 16, 1913, for frequent and painful urination. This condition had existed for two years. She is compelled to urinate every hour during the day and arises four to five times at night, sometimes oftener. She complained of sharp pain above the bladder and pain extending from the right kidney to the ureter. Palpation elicited a tender and somewhat enlarged right kidney. It was slightly ptosed.

Cystoscopy disclosed two papillomata each about five mm. in diameter near the right ureteral orifice. The right ureter and meatus were congested. A No. 5 renal catheter was introduced into the right ureter and met with an obstruction at the pelvic brim. I collected 15 cc. of urine filled with flakes. At this time I injected 10 cc. of 1–5,000 nitrate of silver solution. The left ureter was catheterized. An examination of these specimens showed pus, blood and round cells from the right kidney, the left kidney was normal. The urine taken from the right kidney was injected into a guinea pig, tubercle bacilli were not found.

Three days later pyelography and ureterography showed a slight kidney displacement, some dilatation of its pelvis, a kink of the ureter at the pelvic brim but no foreign body.

The problem was to deal not only with the bladder but the right kidney as well. I could see no reason why I should not remove the papillomata with the high frequency current and at the same time irrigate the pelvis of the kidney. Consequently I attempted both. I passed a No. 7 renal catheter to the ureteral obstruction and irrigated the kidney pelvis with 1–5,000 nitrate of silver solution, following with a normal saline.

Seven days later I treated one tumor with the D'Arsonval current. I projected the wire directly into its center following my usual technique. After the third application, I removed the wire and inserted a new piece, giving three more applications at another portion. Very little reaction following.

In three days she returned for a second lavage of the kidney pelvis. Cystoscopy showed congestion at the site of the tumors. She complained of more backache.

Three days later the second D'Arsonval treatment was given. The wire was projected into the other growth and the usual number of applications given with the rheostat on the second button. Very little reaction followed.

Three days afterwards, a third irrigation of the kidney pelvis was given, using 1–5,000 nitrate of silver solution. She complained of an increase in backache which a kidney corset did not relieve. The urine withdrawn from the kidney at this time showed pus and blood cells, was acid in reaction, and contained albumin. The bacillus pyocyaneus was isolated.

Ten days later she returned for another treatment with the D'Arsonval current, complaining of increased bladder and urinary symptoms. At this time I decided to refrain from irrigating the pelvis of the kidney, thinking it was aggravating not only the kidney but also the local bladder condition. The larger tumor showed areas of dessication in the center but was proliferating around the edges. I then attacked its periphery.

She refrained from any local treatment whatsoever until three weeks ago, being compelled to resume them because of increased urinary discomfort. Cystoscopy showed a slight increase in the size of the tumors. I have since given her three treatments of six applications each with the D'Arsonval current. The local bladder conditions are decidedly better and the growths have almost disappeared. I have not attempted lavage of the kidney pelvis.

I submit that there must be some pathological condition of the right kidney and ureter which when irritated by renal lavage increased the bladder discomfort; otherwise, despite the high frequency treatment why should the tumors grow?

CASE 6. J., railroad conductor, age 58, patient of Dr. Garner of Norristown, Pa. Diagnosis: Small papilloma vesicæ. D'Arsonval current, one treatment, cured.

History. Patient was referred two years ago for prostatectomy. Recovery was uneventful. A slight incontinence of urine persisted. Under cocaine I shaved off a small piece of tissue through the operating cystoscope. The incontinence improved materially.

About three months ago he consulted me again for frequent urination, the incontinence however was not annoying. Cystoscopy showed a small papillary growth about three mm. in diameter situated below the right ureteral orifice. I applied the D'Arsonval current, giving six applications of four hundred and twenty-five ma. with the rheostat on the second button.

A few days ago he reported a decided improvement in the urinary symptoms. Cystoscopy shows a normal bladder.

CASE 7. J., age 69, retired, patient of Dr. Iszard of Haddonfield, N. J. Diagnosis: Villous epithelioma vesicæ. Treatment with D'Arsonval current, amelioration of symptoms.

History. I was asked to cystoscope this patient at his home on December 3, 1911, to determine the cause of a prolonged hæmaturia. Bleeding had been intermittent for a period of five months. Inspection of the contents of the vessel showed large clots and foul bloody urine. He urinated hourly both by day and night. The act was extremely painful and there was considerable suprapubic, perineal and kidney distress. The lateral lobes of the prostate were enlarged. He was somewhat anæmic.

An attempt was made to cystoscope him. Irrigation of the bladder caused bleeding. Eventually, however, a sufficiently clear field was obtained so that we could see the source of the hæmaturia. I suggested placing him in a hospital for observation. It is within the experience of every cystoscopist that sometimes upon attempting cystoscopy on patients who have bladder tumors, that the stretching of the bladder wall incident to irrigation causes bleeding which prevents a clear view. Under such circumstances, I follow the plan adopted in this case, prescribing fifteen grains of urotropine, three times daily, plenty of water. After several days rest, this usually cleanses the bladder permitting cystoscopy with urine as a medium. The tumor was in an unusual position, at the summit of the bladder on the left side. It was about fifty mm. in diameter, covered with villi and showed areas of ulceration, in fact, presenting every evidence of malignancy. It was distinctly inoperable from a surgical standpoint, representing that type of tumor concerning which we say "hands off." Both the physician and the patient were anxious to have the high frequency treatment employed. I promised nothing at all, but trusted that with it I could control the hæmorrhage, check the spread of the growth and thus prolong his life, apparently an almost hopeless task.

He was brought to my office for treatment every seven days. The usual technique was employed at each seance, giving about four hundred and twenty-five ma. with the rheostat at the third button. He remained under my charge nearly seven months, having been given about thirty-

five treatments. Bladder irrigations of 1–5,000 nitrate of silver solution were given daily. He suffered very little reaction following these treatments. I am confident that he was relieved, since after eight or nine seances he had but little bleeding. The tumor diminished in size, although I could see several daughter tumors scattered over other portions of the bladder. To these I gave several treatments from time to time, and succeeded in destroying the smaller ones. In the early part of June the cystitis became more annoying and he expressed himself as "instrument sore." I submitted to him the idea of opening the bladder, removing the prostate, together with as much of the growth as possible and then using the D'Arsonval current through the open wound. Shortly afterwards, however, he became very anxious to return home. The attending physician continued bladder irrigations, very little bleeding occurred. He died in October, 1912, from uræmia.

CASE 8. Mrs. X., age 43, referred February 10, 1913, for urinary frequency and distress. She was compelled to urinate five times at night and hourly during the day. A slight incontinence existed. This had persisted for seventeen years, growing in severity following childbirth. At times the urine was slightly colored with blood. She complained of suprapubic distress and kidney ache, referred to the right side. She gave a family history of malignancy.

Abdominal examination elicited slight ptosis of the right kidney and marked sensitiveness, sensitiveness about the appendix and suprapubic region. The perineum was relaxed, due to an old unrepaired tear. The cervix was slightly ulcerated, but soft. The ovaries were apparently normal.

An analysis of the common urine showed specific gravity 10.22, an acid reaction, slight trace of albumin, blood, round cells, pavement epithelia and pus. The urea was 1.9 per cent.

Cystoscopy showed trigonitis, areas of cystitis worse about the orifice of the right ureter. The orifice was puffy and suggested renal involvement. I catheterized the right kidney. The urine showed round cells, small amount of pus, blood and albumin. The specimen from the left kidney was normal. I removed the catheterizing cystoscope and sweeping a Zeiss magnifying scope around the field discovered a tumor at the vertex to the left of the center. It was twenty-five mm. in diameter, sessile and showed areas of ulceration. It was clinically malignant. I removed portions of the growth for microscopic analysis but the report was non-malignant, the pathologist asked for a larger specimen. She was placed on daily bladder irrigations of nitrate of silver solution 1–5,000 for a week before commencing the high frequency treatment. Following the second treatment, she was decidedly improved. I have treated her weekly since, the last time using four hundred and twenty-five ma., the rheostat at the fourth button. The cystitis is disappearing, the growth diminishing, she has gained five pounds in weight and is still under treatment.

CASE 9. Mrs. M., age 63, patient of Dr. E. W. Howell of Philadelphia. Diagnosis: Sessile papillomata vesicæ. Treatment with the D'Arsonval current, two treatments, still under observation.

History. Was referred April 20, 1913, for cystoscopy to determine the source of hæmaturia. This was the onset symptom. Previously she had not complained of any urinary discomfort. She is a tall, thin, wiry, well preserved woman.

The urinary analysis showed specific gravity 10.28, albumin, blood, pus slight amount, urea normal.

Cystoscopy showed three tumors, one irregular, resembling a lozenge about five mm. long and two mm. in depth, situated just within the sphincter; another circular in shape, about five mm. in diameter, situated between the ureteral orifices, and a third and smaller one close to it.

I have given the large tumor two treatments, at the first giving six applications, using a current of four hundred and twenty-five ma. The second was given one week later. I then employed a current of four hundred and fifty ma., with the rheostat on the fourth button, giving at this time ten applications for thirty seconds each, with an interval of rest of thirty seconds. No reaction whatever followed and the hæmaturia has ceased. The case is still under observation.

CONCLUSIONS

From my experiments and cases, I think that I have shown the curative properties of the D'Arsonval current.

1. In benign tumors, it is superior to the Oudin current because with it you take no chances whatever.

2. With the Oudin current there is a possibility of feeding the growth.

3. Concerning border line cases, in numbers two, three and eight, I have shown the benefit derived from the D'Arsonval current.

4. In distinctly malignant cases its value remains to be proven. In case number seven I believe that I prolonged life and made him more comfortable.

5. Cases cited by Keyes and Pilcher show its value over other methods of treatment.

6. The D'Arsonval current does for tumors of the urinary bladder even more than surgery.

7. As to its value compared with that of radium and fulguration by the DeKeating Hart method, I am not prepared to say, since in medical literature I am unable to find any references to their value in tumor of the urinary bladder.

A question which must be solved is, "Is tumor of the urinary bladder only evidence of similar involvement of other parts of the genito-urinary system?" It would appear that in cases two and five papillomatous degeneration of the kidney and ureter might co-exist with a similar condition of the urinary bladder.

A METHOD OF CONTROLLING HÆMORRHAGE IN THYROIDECTOMY

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EVERY ONE who has done much operative work on the thyroid has at times encountered extreme difficulty with hæmorrhage. At such times every operator must have wished for a safe and easily executed procedure by which the entire blood supply of the gland-half involved could be controlled before the actual steps of the resection were begun. The superficial location and easy accessibility of the superior thyroid artery eliminates all difficulty of controlling hæmorrhage from this source. With the inferior thyroid, conditions are different. Its deep situation and intimate relation with important structures renders its exposure difficult. Yet the importance of controlling hæmorrhage from this source was so clear in the minds of the pioneers in the field of thyroid surgery (Velpeau, Kocher, and others) that they regularly exposed and ligated this vessel by dislocating the gland inward, before beginning the actual resection.

But the frequency of injury to the recurrent laryngeal nerve, and the occurrence every now and then of post-operative tetany due to destruction of the parathyroid bodies, gradually lead to widespread dissatisfaction with this procedure and it has now been quite generally abandoned in favor of the so-called "intracapsular method," in which the branches of the inferior thyroid are ligated within the substance of the gland, the posterior capsule is left *in situ*, and therefore the structures beneath it are uninjured.

The thyroid arteries or their branches penetrate immediately into the substance of the gland, while the veins spread out superficially on or just beneath the true capsule. Often in the presence of goiter these veins become enormously dilated and their walls extremely thin. This condition leads at times to troublesome and disconcerting hæmorrhage in carrying out the steps of the ordinary intracapsular operation, and makes one wish that there might be a procedure by which the inferior could be ligated at the beginning of the operation without endangering the recurrent laryngeal or the parathyroid bodies.

In order to appreciate the feasibility of such an operation, a brief review of the anatomy of the thyroid region of the neck is important.

The thyroid is covered anteriorly by the sternomastoids and the so-called vertical muscles, the sternohyoid and sternothyroid. These muscles are surrounded by connective tissue sheaths, which are divisions of the middle layer of the cervical fascia. The sheath of the vertical muscles forms quite a firm fascia, which unites with the deep layer at the midline, and laterally and posteriorly joins it also but does not become incorporated with it. If we divide the vertical muscles together with their sheath, we come upon another layer of fascia which crosses the midline and completely surrounds the thyroid gland. This has been called the external or surgical capsule, which is an unfortunate term since it implies something pathological, whereas in truth it is a perfectly normal anatomical structure, being one division of the cervical fascia. A more correct term would be the thyroid fascia. This fascia can be quite readily stripped off, leaving exposed the gland covered by its true capsule. In the space between the fascia and true capsule course the network of superficial veins, and posteriorly are located the parathyroid bodies, the recurrent laryngeal nerve and the terminal portion of the inferior thyroid artery. The union between the fascia and true capsule is normally very loose, only posteriorly at the point of entrance of the vessels the fascia is thickened and closely united to the capsule.

Poulson, in studying the anatomy of the neck in relation to the formation of abscesses and the spread of pus through the cervical tissues, developed a method of injecting the fascial sheaths with colored gelatine by which he was able to study their course and relations. He found that the fascial layers surrounding the muscles, vessels, and other structures of the neck, formed a series of completely closed tubes. Some of the points in his study throw light on the relations of the inferior thyroid artery.

Inject gelatine between the sternomastoid muscle and its posterior sheath, and a space is brought to light which extends backward and outward to the sheath of the carotid vessels and nerves.

Inject gelatine under the fascia surrounding the vertical muscles of the neck and another space is demonstrated, which extends almost directly backward to the fascia covering the deep muscles of the neck, and touching the carotid sheath on its inner aspect.

Inject gelatine under the thyroid fascia and another closed space between it and the thyroid

gland is demonstrated, in which lie the superficial thyroid veins and parathyroids.

If the sheath surrounding the carotid vessels is exposed at the angle of the jaw and gelatine injected under it, the liquid flows as far down as the thoracic aperture and brings to light still another closed space which contains the carotid, jugular, and pneumogastric, and appears in a cross section as a sharp, wedge-shaped area lying on the prevertebral fascia.

The inferior thyroid artery lies in its whole course behind this sheath. It runs at first upward to a point about a finger's breadth below the carotid tubercle, then turns, forming its well known arch with the convexity upward, runs downward, then inward, and pierces the thyroid fascia at the point where it is crossed by the recurrent laryngeal nerve, and then enters the gland.

A further discussion of Poulson's study would have no interest. Indeed, for manifest reasons, facilities were not available for repeating his experiments. I did believe, however, that careful dissection would be able at least to show whether the spaces which he describes were actual anatomical realities or mere artificial products. I have made a number of such dissections and am convinced that the principal spaces which he describes do actually exist and can be made practical use of for surgical purposes. In the light of this knowledge it is plain to see why the method of exposing the inferior thyroid by dislocating the gland forward and inward placed both the parathyroids and recurrent laryngeal in danger, and accounts for their frequent injury. It also explains why former methods such as that advocated by Drobnik and Woelfler, by which the inferior thyroid was reached from the outer side of the sternomastoid were awkward and unsatisfactory though perfectly safe so far as the parathyroids and recurrent laryngeal were concerned.

Being satisfied then that we have such a space within the sheath of the sternohyoid and sternothyroid muscles, it becomes evident that here we have an avenue by which the inferior thyroid artery may be exposed with safety to the structures connected with the posterior capsule, since the thickness of the thyroid fascia intervenes; and without injury to the carotid, jugular, or pneumogastric, since the sheath is unopened.

The following in brief are the steps of this procedure:

The usual transverse collar incision is made, dividing the skin and platysma. The upper flap is freed to the upper border of the thyroid cartilage Then at a point opposite the middle of the thyroid cartilage the fascia over the verticle muscles is slit in a longitudinal direction a finger's breadth inside the border of the sternomastoid muscle.

This slit is extended upward and downward for a distance of about two inches. With narrow bladed retractors the fascia of the sternohyoid and the sternomastoid muscle is drawn outward, the sternohyoid and sternothyroid muscles inward. The finger is pushed down through this space until the pulsations of the carotid are felt. By blunt dissection the fascia just to the median side is penetrated when the finger is felt to be in the loose areolar tissue in front of the longus colli muscle. Retractors with longer blades are then substituted. The sternomastoid and carotid sheath are drawn well outward while the vertical muscles and thyroid gland are displaced inward. The space back of the carotid sheath is in this manner well exposed. The carotid tubercle, which is the important landmark, should now be located. About a finger's breadth below the tubercle, the artery is sought for with two pairs of blunt dissecting forceps. It lies in the loose connective tissue and at the extreme point of its arch seems to be surrounded by a sling of rather firm fascia which binds it to the carotid tubercle. When a short area is freed, a ligature may be passed around with an aneurism needle. The ligature is tied, the retractors removed, and the parts allowed to fall back to their natural places, and the operation of intracapsular thyroidectomy proceeded with in the usual manner. I have worked out the steps of this procedure on ten cadavers, enough to satisfy myself of its technical feasibility. I have also had the opportunity of carrying it out once on the living patient, a woman of 38 with a moderately large colloid goiter which had been giving rise to pressure symptoms. The surface of the goiter was covered with numerous dilated thin-walled veins which, I am sure, would have caused very troublesome hæmorrhage with the usual procedure. I found the inferior thyroid and ligated it without difficulty, in fact, requiring no more time than it has taken to describe the steps of the operation. In one respect it was easier in the living patient than on the cadaver. The pulsations of the artery greatly facilitated finding and exposing it. The subsequent steps of the operation were greatly simplified. Some of the larger veins were ligated for fear of the possible entrance of air into them. A much cleaner dissection was possible when freed from the annoyance of constant hæmorrhage. It was possible to remove

the goiter leaving an intact capsule with a thin layer of gland tissue attached, which I found I could fold over and sew together in such a way as to leave no raw surface exposed. The parathyroids and recurrent laryngeal were not disturbed, and did not come into view during the operation.

It is not the intention to recommend this operation as a routine procedure. In fact, in the majority of thyroidectomies, I think it unnecessary. But now and then cases will be encountered which are so vascular that such a procedure will be of distinct advantage. For such cases I can recommend it as being both safe and practical.

I presume that objections may be raised to this operation on the ground of anatomical variations in the course and even in the presence of the inferior thyroid. I am aware that such anatomical variations do exist, but I do not believe that they are of sufficiently frequent occurrence to constitute a serious objection. I do not believe that the presence of a large goiter will materially disturb the relations of the artery behind the carotid sheath.

In my dissections, I found in every cadaver that the artery at the top of its arch was surrounded by a sling of firm white connective tissue which extended upward and was attached to the carotid tubercle. It would seem that this sling would be sufficient to prevent much displacement of the artery.

Another objection that might be urged is that the division of both superior and inferior thyroids outside the gland, together with a division of all the gland substance at the isthmus, would so impair the circulation of the posterior capsule left behind that the parathyroids would atrophy. Investigations have been made which go to show that there exists an anastomosis between the vessels of the thyroid and the surrounding structures. Woelfler showed that ligation of all the thyroid vessels in the dog was unable to produce necrosis of the gland if it was left undisturbed in its bed. Only when it was dislocated from the surrounding structures did necrosis follow. Delore and Alamartine have shown by anatomical preparations the existence of such an anastomosis in man also.

Experience in my one operative case leads me to believe that enough circulation remains to supply the parathyroids. A small but persistent oozing was noticed from the raw surface of the posterior capsule which persisted until the edges were folded over and sewed together.